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FOREST POLICY IN BURMA.

BY H. C. WALKER, I.F.S.

When acquiring land for the purpose of forming State forest reserves, it has hitherto been the practice to exclude all land from which villagers have been accustomed to obtain their requirements of forest produce. This practice appears to have originated in the belief that villagers possessed rights over the land and forest growth in the vicinity of their villages. Thus, in his "Forestry in British India," Mr. Ribbentrop, a former Inspector-General of Forests, stated that "though the Oriental Governments, from which the British Government inherited its forest property, never recognised a prescriptive right, it had to be admitted that, under the system originally in vogue, and which had remained entirely unchecked for some time after the British occupation, rights of user had, in some instances, been acquired by the legal process of prescription, in consequence of the substitution, or at least admixture, of Western laws and ideas, in cases where it had been exercised neither by force nor secretly, but fully openly, and unchecked, for 62 years."

For this reason, and possibly also for reasons of policy, great care was taken not to prejudice the interests of villagers by reservation. It was taken as a matter of course that the boundaries of a proposed reserve should be thrown back three or four miles in order to leave a large forest area for the use of even a small village of about 20 houses. As an instance of the policy adopted, in the Tharrawaddy division two or three villages of Karens were found situated in the heart of some of the finest teak forests in Burma. There were only about half a dozen houses in each village, and in those days there was ample land available for shifting cultivation outside the proposed reserve, but instead of removing these villages, or almost allotting to them the smallest possible area compatible with their needs, a large area, amounting, I believe, to several square miles per family, was specially demarcated out for them within the reserve.

In some cases, generally in order to obtain a more satisfactory boundary along a natural feature, it was found necessary to bring the boundary of a proposed reserve so close to a village as to include land of use to the villagers; and, in such cases, definite rights of extraction to be exercised for all time were granted under the Settlements.

It seems very doubtful, however, whether villagers had ever legally acquired definite rights of user as suggested. The usual method of acquiring land in Burma is merely to bring it under cultivation for field crops; and, in such cases, the cultivator removes the forest growth, however indispensable it may be, and regardless of the fact that villagers have, from time immemorial, been accustomed to obtain their requirements from the area. In any case, Government does not appear to have recognised such rights, but immediately after the conquest of Pegu issued a notification, dated the 26th September 1853, declaring all forest lands to be the property of Government and proceeded to exercise its authority as owner. For instance, although cultivators had, from time immemorial, been accustomed to fell immature Pyinkado trees and to utilize the timber as house-posts and for making ploughs, Government prohibited the felling of this tree without license. Again,

Government reserved to itself the right to issue to traders licenses for the extraction of any forest produce, however indispensable it might be to cultivators. On the other hand, in the Rule prohibiting the felling of trees on waste land, provision was made that any villager might freely extract timber of the unreserved kinds within 10 miles of his village for domestic, agricultural or piscatorial purposes. This does not, however, necessarily imply the admission of a right, but appears to be merely a concession which can be modified or cancelled at any time.

I am not a legal expert, but nevertheless am inclined to the opinion that the grant of permanent rights in reserves is unnecessary. It is only reasonable that no village should suffer by reservation, but in cases where it is necessary to bring a reserve boundary close to a village, I think it would suffice to exclude sufficient land capable, under intensive management, of satisfying the requirements of the villagers, and in addition to grant temporary privileges in respect of forest produce within the reserve so as to place the village on an equality with villages more remote from the reserve. Hitherto the rights granted have caused no inconvenience, but experience in more advanced countries proves that rights granted, at a time when a country is undeveloped, gradually become an unmitigated nuisance.

The principal field crop of the country is paddy, and there is, therefore, a natural tendency for population to gravitate into the plains. There have always been a certain number of people, however, who, by choice, or because they have not the capital for permanent cultivation, earn their livelihood by shifting cultivation. Except in the case of hill tribes, there is a tendency for these people to keep in touch with the larger villages in the plains, and to congregate into the foothills leaving the main watersheds untouched. The policy of excluding all villages and of leaving them an ample amount of land has, therefore, not prevented the Forest Department acquiring a very valuable estate, comprising large compact blocks of forest admirably suited for economical methods of management.

Until recently, our energies have been concentrated on the organization of our teak forests, which includes examination of

areas with a view to reservation, settlement, demarcation, survey, and valuation for the purpose of framing working-plans. Although this work is practically completed, there remains a vast amount of work to be done in developing these forests and in improving the growing stock. Even in the finest teak forests there is only a thin sprinkling of teak in a jungle of unmarketable rubbish. At present our teak forests yield only about half a crore of rupees, or possibly less, whereas eventually they should yield at least ten crores of rupees; but to obtain the highest possible production will be a very gradual process, and will involve an enormous amount of work. Moreover, there appears to be a world shortage of timber, and it seems practically certain that when conditions become normal, it will be possible to export, at a profit, large quantities of timber of species such as In (*Dipterocarpus tuberculosus*). This species tends to form pure forests, easy to work, and is found on laterite or gravelly soils, unsuited to field crops, and as I understand that large compact blocks of forests of this species could be acquired without affecting the interest of villagers, these areas should, therefore, be reserved and exploited. There are also prospects of developing a large trade in Pyinkado for railway sleepers, mangrove bark for tannin, bamboo for paper-pulp and inferior timbers for distillation.

It has been suggested that the Forest Department should take steps to reserve all land unsuited for field crops; but, in my opinion, such a policy would only result in the neglect of existing reserves, and I think most Forest Officers must admit that, even if we adhere to our present policy of excluding the more accessible lands from which villagers and traders are accustomed to obtain their requirements, and, on the other hand, the more inaccessible lands or lands covered with inferior and unmarketable tree-growth, there is sufficient work in sight to occupy the whole of the energies of the existing staff or of any conceivable increase of establishment which is likely to be sanctioned for many years.

It is necessary, however, to consider the question from an entirely different point of view, and to take into account the question of local requirements. In the early days of British Rule

there appears to have been ample forest produce for every one. For instance, even in the plains, there appears to have been a considerable amount of virgin forest, as is proved by the fact that even under the policy adopted the Forest Department was able to acquire, free of right, blocks of forest, such as the Rangoon Plains forest, covered with virgin forest, although the land was suitable for paddy cultivation. Our predecessors had, therefore, little need to study the question of local requirements. The people had always been accustomed to fell timber how and where they liked, and to have interfered with this custom would have caused friction at a time when it was particularly desirable to cultivate pleasant relations with the people and to inspire a spirit of confidence. Since those palmy days, conditions have changed very considerably. In the first place, the rapid extension of cultivation has reduced the area under forest growth, and the resultant increase of population has enhanced the demands on the remaining area. Further, with more settled conditions, the standard of comfort has increased with the result that the consumption of timber per head is greater than formerly. In addition, villagers and traders continually pick out the more valuable species in the best and straightest stems, and thus there is a steady and constant force at work making for the survival of the unfit.

There is a natural tendency to underestimate the deterioration of the unclassed forests. Land not actually under cultivation, even near large towns and villages, is usually covered with dense vegetation of sorts, and the average European does not concern himself with the value thereof. He may not know what species are subject to rapid decay, or difficult, and almost impossible to work; and whether stems are branched or crooked is to him a matter of indifference, the process of deterioration has also been obscured by the increasing wealth of the country. As one forest becomes exhausted, all that has happened is that traders have gone further afield, and the resulting increase of prices has been met by a greater ability to pay. The fact that in Burma enormous areas are covered with forest and that teak can be profitably worked even from the most remote forests is apt to create the impression

that, if necessary, other species could be worked out. Teak is, however, worked out by elephants, the supply of which is limited. It floats when dry, and commands a very high price owing to special qualities. Timber is very difficult to transport and, therefore, the whole question turns on accessibility so long as there is an adequate supply of good timber close at hand, prices are low, and every one is very happy, but with a steadily increasing population and with every trader and villager striving to obtain the best timber he can from the most accessible forests, these forests become exhausted and are never given a chance to recover. The next most accessible forests are then attacked, and these are in turn exhausted. Meantime the cost of timber steadily increases, and it is obvious that, if the process is allowed to continue unchecked, prices will go on steadily rising, until eventually, although there is ample land available, the cost of timber will become almost prohibitive.

The danger seems to be fully recognized—at least by forest officers—and I believe the proposal that all land not fit for the production of field crops, and in fact fit for nothing but forest crops, should be reserved, has been put forward as a remedy for the steadily increasing deterioration of unclassed forests. Most forest officers, during their course of practical training in Germany, have seen an occasional village forest of which the nett profits have been handed over to the villagers, but the management left entirely with the State Forest Officers ; and, I think, the idea underlying the proposal is that similar village forests should be formed, by acquiring small tracts of forest for each village and by regulating the yield under the working-plan, the Forest Department doing everything while the villagers look on. In Germany, however, there are very few village forests, certainly not more than one on the average for each forest officer, whereas in Burma there are hundreds of villages in each division and ample land available. Hitherto in acquiring land for reservation, we have only taken up land of no use to any one, and have supported our proposals by somewhat rough sketches, except where the area borders on a village. The reservation of land in the toothills, honeycombed

with villages, would obviously be a very much more difficult proposition. Up to date, *i.e.*, in the last forty years or so, we have only reserved an area of under 30,000 square miles, whereas the area of waste land, practically the whole of which is unfit for field crops, is over 140,000 square miles.

Reservation would alone be a large undertaking. Settlement and demarcation would also be difficult. Hitherto our working-plans have been fairly simple (but incidentally somewhat expensive) as only one species has been considered, and compartments have been made of large size. The requirements of villagers are various—fuel, bamboos, house-posts, timber for dugouts and for house-building—and the quantities required annually for each village comparatively small, and altogether a working-plan would be complicated, and as thousands of small plans would be required the operation would take many years.

In my opinion, therefore, the formation of village forests on the lines of German village forests is impracticable, and it is significant that, although many years ago special rules were framed for village forests and included in the Forest Act, as yet not a single village forest has been formed. In forming any opinion on the question, I think it essential to take into consideration the question of finance, and on this account any scheme which entails a large and expensive establishment must be ruled out of the question. Even at present the staff maintained to protect the unclassed forests is financed to a great extent out of our revenue from the teak reserves, and I would deprecate any further diversion of funds which are urgently required for the development of the reserves. Another point to which, I do not think, sufficient attention has been paid is the feelings of the villagers themselves. In every country the people are accustomed freely to help themselves to the wild products of nature. Even in England the natives pick wild products, such as mushrooms and black berries, even for trade purposes, without applying for permission, and regard it as a sort of right. In Burma the people have always been accustomed to fell timber, how and where they liked, and even if the Forest Department prepared a working-plan for a patch of jungle, I doubt

whether the villagers could be induced to observe the provisions, although to their interests to do so. Another point which has to be considered is that in many of the more accessible forests, where the demands are very great, there remains little timber of any value to be protected or regulated.

My own opinions have been greatly influenced by my experience at Mawlaik, a new head-quarter station. A considerable amount of tree-growth had to be cleared away for sites for houses and offices and at the same time there was a great demand for timber for house-building; but practically none of the trees felled could be utilized for this purpose. Many of them were of fair size, and the jungle did not appear to have been heavily cut over, but the trees were of unsuitable species, or of bad shape, or otherwise incapable of yielding useful logs. On the other hand, I have recently had an opportunity to see some interesting experiments in the Katha division and in particular was greatly impressed by the fine growth of Yemane (*Gmelina arborea*) in a plantation a mile or so from the railway line. This species is in great demand by villagers and has been almost exterminated in many unclassed forests. It is of very rapid growth and is said to attain marketable dimensions in about 40 years, and as the cost of forming such plantations is only two or three rupees an acre, the profits will be very great.

The question arises, therefore, whether villagers could not be induced to plant up waste lands with valuable species of trees such as Yemane. It must be admitted that hitherto they have not shown any ardent desire to do so, but they themselves admit that they lack initiative and they have no experience of conditions in developed countries. On the other hand, they seem to respond readily to suggestions by District Officers in whom they have confidence. I have seen it stated, but cannot find the reference, that in one district a large number of bamboo groves were formed near villages merely as a result of a keen Deputy Commissioner impressing on villagers the advantage they would gain by doing so. Throughout the Chindwin there is a net-work of roads made by villagers at the suggestion of District Officers. The villagers

receive no pay for the work, but turn out annually in a body and clear the roads half way to the next village. The success of the war loan is another instance of the influence of Deputy Commissioners, and I think it by no means improbable that in the congested areas where the scarcity of forest produce is being acutely felt, villagers could be induced to plant up waste lands near their villages.

I would further suggest that the provision in the Forest Manual allowing villagers to extract unreserved timber without payment within 10 miles of their village should be cancelled or modified, by restricting free extraction to the village tract. The present restriction is very arbitrary, as it is often cheaper to extract timber 100 miles to go down a river, than to drag it a very short distance across difficult country, and the restriction is difficult to enforce. By modifying the rule, it would bring home to villagers the fact that they cannot expect always to get a free supply of timber, and would, therefore, encourage reclamation of waste lands. I consider also that the village tract would form the only possible basis of any scheme of village forests and would suggest the object to be aimed at, is to induce every village to plant up all the waste lands within the village tracts.

In modifying the rule, I would suggest conferring on villagers the privilege of exacting felling fees, subject to a maximum of, say, Rs. 1-8-0 a tree, from other villagers who require timber for their own use and not for trade. The effect, therefore, would be to abolish the 10-mile restriction so far as the Forest Department was concerned, and incidentally make it clear to the villagers that the object of modifying the rule was not to squeeze more revenue out of the people. At the same time, I think villagers should be given to understand that any revenue received on this account should be spent on planting up waste lands. When making teak plantations, the Forest Department utilizes the services of taungya cutters and pays them a small sum for sowing teak with their main crop; and my object in making this suggestion is to create for villagers a small source of income which could be utilized for financing a similar policy. After all there is a certain amount of

reasonableness in requiring outsiders who want forest produce to pay for the cost of measures to protect the future supply.

A further question which naturally suggests itself is whether in congested areas taungya cutters could not be prohibited from cutting taungyas, except on the condition that a tree crop is sown with their main crop. If, at the same time, they received a reasonable payment from the village community, little hardship would be caused. At present taungya cutters do a considerable amount of injury ; but, in this way, they would become useful to the general welfare of the country, and might gradually develop into woodsmen and earn their livelihood by felling and logging timber and replanting the areas cleared.

The amount of waste land in a village tract unfit for field crops, but suited for forest crops, is unequal, and usually varies in inverse proportion to the population. At the same time, the distribution is not inequitable ; and, generally speaking, it seems desirable that the poorer villages with little first class paddy land should cater for the requirements of the more prosperous villages. There is, however, ample land for everyone ; and, if necessary, the Collector could either alter the boundaries of a village tract, or allot a tract of land to any enterprising municipality or village community on the condition that the area be planted up within a given period. Similarly, if the Forest Department wished to acquire accessible, and therefore valuable, land for the production of fuel for locomotives or steam launches, I would suggest that, instead of acquiring land by the process of reservation, the land should be gradually acquired by reclamation, in the meantime both villagers and the department being allowed to obtain their requirements from the waste land on equal terms. This would cause little friction and would avoid the troublesome question of settlement.

I have already suggested that any restriction on produce extracted by villagers for their own use should be enforced not by the Forest Department, but by the villagers themselves. Government would still be the owner of all forest produce and would retain the right to sell any timber to traders under a system of icenses, and I would further suggest that the villa ge headmen

should be held responsible for protecting the interests of Government, and for supervising the work of licensees. At the same time, I would make it worth his while by authorizing him to exact felling fees. The felling fees could be fixed at, say, four annas or over eight annas a tree, payable by the licensee. For this fee the headman would be required to prevent any trader felling timber within his village tract without license, to prevent undersized trees being felled, and to insist on logs and stumps being marked with the traders' property mark. On completion of the work, he would be required to endorse the license with the number of trees felled and logs obtained. It would not be necessary for the headman to watch every tree being felled. In many cases, the villagers themselves do the felling and logging for traders, and he could find out from them whether the rules were being observed. The Forest Department could then reduce the number of beat officers, or rather utilize the services of these subordinates for purely forest work in the reserves, only maintaining a small staff along the rivers and railways for assessing timber extracted for royalty.

Land from which mature timber could be extracted to the market at a cost of Rs. 5 a ton is obviously of great potential value as compared with land from which timber could not possibly be extracted at a cost of less than Rs. 20 a ton. Generally speaking, the land which the Forest Department has reserved is of very low value, for the reason that under the policy adopted we have not taken up the more accessible land from which villagers and traders obtain their requirements. For the most part, the reserves consist of large compact blocks of forests on the main watershed, the majority of which could not be worked except by elephants, or wire rope-ways, or except opened out by a costly scheme of roads or tramways. It is inconceivable that such forests could be properly managed, except by the State and by a trained and qualified staff. At the same time, although the land is of little value the growing stock is often of considerable value owing to the natural protection it has received on account of its inaccessibility. For instance, in the Upper Chindwin there are two blocks of reserves under working-plans comprising 497 square miles.

These forests are quite inaccessible either for traders or villagers, and yet Government has derived from them for the last four years an average annual revenue of Rs. 5,57,667, or roughly a lakh per 100 square miles. The amount spent on improving the growing stock, including the cost of fire-protection which is of doubtful advantage, only amounts to Rs. 13,772 a year. It is evident, therefore, that the process of development has hardly begun. I maintain, therefore, that the Forest Department should concentrate its energies on developing reserves such as these ; and, incidentally, I would observe that I think the policy for these areas is not reclamation, which involves the destruction of existing crop, but restriction of the yield to the natural production, and improvement of the growing stock by the removal of worthless species, more especially where these are suppressing and killing valuable species.

On the other hand, land from which villagers and traders obtain their requirements is comparatively of great potential value. Naturally, when everyone is allowed to fell timber, how and where he likes, the most accessible areas are the most heavily worked over, and therefore the greater the potential value of the land the less valuable is the growing stock. For the most part the land is honeycombed with cultivation ; and although the total area of land unfit for field crops is very great, the land available is often found in small patches with no natural features as boundaries. Such land is most unsuitable for management by the State, but excellently suited for management by village communities for the production of timber for their own requirements. In such cases, in my opinion, the most practical policy is to encourage and, if necessary, insist on reclamation. Villagers regard with indifference forest growth being destroyed by traders or outsiders by taungya cutters or by cultivators wishing to plant field crops, but would oppose the enclosure of forest land by the forest officer and the regulation of the yield, and therefore it is a policy of the least resistance. The troublesome and expensive questions of examination, settlement and demarcation are entirely avoided. The expense of forming these plantations would be very small, the

highest possible results per acre would be obtained, and where the land is close to the market and the timber exploitable by cart, the profits would be very great. Such plantations would naturally be classed as village forests, for which special rules would have to be framed to protect the crop from traders and outsiders.

Such forests would be quite distinct from unclassed forests, and each year the village forests could be gradually extended, until all the waste lands in the tract had been reclaimed. At first a working-plan would not be necessary, but when all the waste land had been reclaimed, a simple felling scheme could be drawn up and would present no difficulty. By a village forest is usually meant one which is formed to satisfy the requirements of the village, but in Burma, I think, we should attempt more than this, and encourage the more jungly villagers to cater for the requirements of the larger villages in the plains which have no waste lands suitable for reclamation. There is no risk of flooding the market as any surplus of valuable timber such as Yemane, Thitya, Ingyin, Pyinkado, Kanyin, etc., would be readily absorbed by the Indian and European markets.

Provided villagers could be induced to undertake the formation of plantations and thus ensure the future supply, I think it would be a pleasing act to relax the rules in respect of unclassed forests. I would merely retain the duties on timber extracted for trade purposes and would abolish all royalties on minor forest produce, firewood and charcoal. These taxes are troublesome to collect, and I do not think the loss of revenue would be great—probably far less than that caused by abandoning the system of extraction contract in favour of purchase contract in the case of teak—and there would be some saving of expenditure by reduction of establishment. Incidentally, the tax on firewood might be reimposed by municipalities as an octroi in order to finance a municipal scheme of reclamation. I would even, if possible, abolish sawpit licenses and removal passes, but would be in favour of registration of sales of timber so that every purchaser could produce a bill to prove that his timber had been lawfully extracted.

I have also suggested that if possible village headman should be induced to accept the responsibility of protecting Government's interests by exercising supervision over extraction by traders. In this case it would be desirable to simplify the license system, and instead of specifying the number of tons of timber to be extracted, to authorize up to a stated numbe rof trees to be felled. Village headmen on the whole seem to be quite as trustworthy as forest guards, and it seems to me satisfactory to make payment according to the amount of work done than to pay a monthly rate.

It necessarily follows from my proposals that I am in favour of the control of the unclassed forests being vested in the Deputy Commissioner, not only nominally but actually. The state of the unclassed forests and the future supply of timber for local requirements is a matter which affects the general welfare of the people very intimately, and therefore concerns the Deputy Commissioner ; and, at the same time, it is a matter which requires little technical ability, and for that reason is not of great interest to forest officers. The Deputy Commissioner is the father and mother of the humble villagers, and he alone has the necessary authority and influence to ensure the success of a comprehensive scheme of reclamation. Assuming also that village headman could be required to exercise supervision over the work of licensees, it is the Deputy Commissioner alone, who could take action against any headman who failed to carry out his duties. However, beyond using his influence I do not think the Deputy Commissioner could reasonably be expected to undertake onerous duties but, as is usual, when any tedious and uninteresting work has to be carried out, such duties would be left to the assistant, which humble, but highly useful job would be filled by the Divisional Forest Officer. The latter would maintain a staff principally along the rivers or railways for the assessment of timber and check in transit. He would also, during the slack season, visit the jungly villagers, and examine the counterfoils of receipts issued by headman for felling trees and compare them with his license registers or trader's accounts.

In conclusion, I would point out that about sixty per cent. of the land in Burma appears to be fit for nothing but forest crops,

and, therefore, if the wealth of the Province is to be increased, it will be mainly by developing the mineral and forest resources. As regards the latter, it is, I think, generally admitted that the more assessible, and therefore more valuable, forest lands, are being gradually impoverished ; and that although the country abounds in forest produce, villagers and townsfolk are paying steadily increasing prices for their requirements and, therefore, I think it high time that a more forward policy was adopted.

FELLING.

BY H. W. BICKNELL (MESSRS. SPEDDING & CO.), KULU.

There is but one method of felling which seems to have been generally accepted and practised, and this is faulty and does not serve well the purpose for which it is intended. This consists in making two cuts in a tree, one about 6″ or 8″ higher than the other ; the lower cut, on the side the tree is intended to fall, is carried through two-thirds of the girth, and the upper cut, from the opposite side, is made parallel to it. In this connection several theories have been advanced which are based on principles too fanciful to be of practical value. Thus Government have insisted in their leases that all trees shall be felled uphill, never considering that the weight lies downhill ; the tendency of a tree grown on a hillside is to throw out branches towards the light, that is, on the downhill side of the bole, and even to lean itself in that direction, the upper side being darkened, either by the hill itself or by growth standing at a higher level. Thus the tendency is for the tree to fall downhill, and it is particularly difficult, and often impossible to make it fall uphill even by the use of strong wire cables. This is because the tree, so long as it is uncut, is too strong and rigid to bend, and before the fibres have been cut through sufficiently the weight will have started an opposite downhill pull ; while once the tree has commenced to fall, no power on earth will keep it back. At the commencement of felling the tree is already inclined several degrees downhill from the vertical, and this may perhaps be put right when it is cut through and made movable if the weight

already lying on the downhill side does not forestall the pull of the cable.

I have ignored the above generally accepted rules, and have adopted what I consider to be the best method, and can claim a fair amount of success for it, having got 98 to 99 per cent. of trees to go where I wanted them, and this with many thousands of trees.

The simplest and quickest method, which labour finds easy, will always be best when large fellings are to be carried out, and I have always made this my rule. I have used saws and wedges and do not care for them ; as they furnish no help, I cannot obtain by other and quicker means. Felling with the saw will never be of use on a mountain side owing to the difficulty of reaching a tree from the lower side, thus rendering it possible to saw through from the upper side only, whereas an axe can be swung round quite a long distance, from where the axeman must stand, and the cut can be carried in any direction. A saw is much slower and more tedious and gets badly pinched. Unless the roundness is cut away from the bole on the side opposite to the saw, the whole weight of the tree has to be raised and upset over a small semi-circular edge, rendering the tree liable to turn over to either side, whilst the work has to be carried on against the weight the whole while. It is, moreover, difficult to get the wedges in properly ; and if they are too small, or get crushed, the tree will balance on its stool, and swing round in any direction, causing danger to the feller ; or a gust of wind catching the top will easily upset it in a wrong direction. If it is necessary to cut out a V-shape, so as to bring the fulcrum to the centre of the bole, thereby lessening the work on the levers or wedges, and also obtaining assistance from the weight, then why not do it by the quickest means ?

The loosing of a large gang of wild, jungly axemen in a forest, under what is supposed to be the control of one man, is about the worst thing that could happen. I remember, when first starting felling in the Kishenganga valley some years ago, I employed a gang of coolies who had worked for the D. F. O., and said they knew all about felling. They first stood round whilst the mate said a prayer or "dewar," as he called it ; then a wild hacking took

place, and soon great giants were toppling in all directions, breaking into pieces as they crashed. I asked where a tree was likely to fall, and was told "Allaha jana." One just missed me, scattering a fire I had been warming myself at, whilst another fell on one of my Munshis, who fortunately came up unhurt through the branches. Damage to the standing crop and to the trees themselves was more than I could allow to continue, and it has been my custom ever since to employ 10 or 20 men in charge of a Munshi and Chaprasi who thoroughly understand their job. Each feller is taught his work before he is allowed to go on with it, and not more then one new man may be taken on at a time, nor the number allowed to exceed the maximum of 20. This causes delay and extends the work over many months, but ensures careful work, much saving of timber, and protection to standing trees. The Munshi has to point out to each man the direction in which the tree is required to be felled, and see that he cuts it correctly, being assisted by his Chaprasi. He keeps a register in which he writes the number of the tree, the name of the felling cooly, and notes if the tree has been correctly felled and the direction of its fall; if it has fallen contrariwise, he is to explain why it happened. He also notes if a tree was branched or roped. This register is constantly inspected by one of my assistants or myself, and this exercises a great check on Munshis shirking work, and sitting preparing false reports in their "daras" instead of going into the forest. An amusing instance of a Munshi so given to preparing his reports from numbers cut off stumps and brought down to him at his "dara" by felling coolies occurred when he reported having branched a number of trees, which the Conservator, on inspection, found had been branched with all the axe-cuts made from below upwards. As this could not happen whilst the trees were standing, they must have been branched after felling; the Munshi, having been round and seen the damage his negligence had caused to the regeneration, had adopted this insufficiently ingenious means of protecting himself.

When deciding in which direction a tree is to be felled, the Munshi makes a careful inspection of it to ascertain to which side

it leans, and he will then direct it towards the nearest gap on that side. A tree will go as much as 45 degrees away to either side from the direction towards which it leans, that is, the uncut fibres are strong enough to hold the weight, whilst the equilibrium is disturbed in another direction, and I have always found room enough to put it somewhere between these 90 degrees without doing damage. When a Munshi is in doubt he must also rope it which ensures success. The direction of the fall having been decided upon, the feller will cut level on that side to about three-fourth the way through, or even more with a big tree, and proportionately less with a smaller one (Plate 11, Fig. 1). This is in order to carry the cut as far back as possible so as to throw forward the maximum weight, while preserving a sufficiently long ridge of fibres or uncut wood to hold the tree from going over sideways. The larger your tree, the further can you afford to take back this edge of the unfinished cut and the more the equilibrium is disturbed in the desired direction. After the forward cut, which is also the lower one, has been completed, the feller starts on the opposite side, exactly in the middle of that part of the circumference which up to now has been left uncut, and works in level parallel to the first cut and about 4″ to 6″ above it (Fig. 1), so that, at the fall of the tree, there is left a narrow ridge of fibres, which are an even thickness throughout (Figs. 2 and 3). If the cuts have been correctly made and are parallel to one another, and the head of a T square is placed up against the edge of fibres in the lower cut, the arm or blade will point exactly in the direction in which the tree will fall.

The object of making one cut higher than the other is little understood. It is done so as to enable the lower cut to be carried in deeper than it could be done were both cuts of equal height up the bole, and at the same time to retain a sufficiently strong ridge of fibres to guide the fall. The stool being higher on the side of the small cut, braces and supports the fibres, and renders an upward and lengthwise pull necessary to break them; but the tree, moving in the opposite direction, need not break them until it has swung several feet, and the fibres only separate and crack

FELLING.

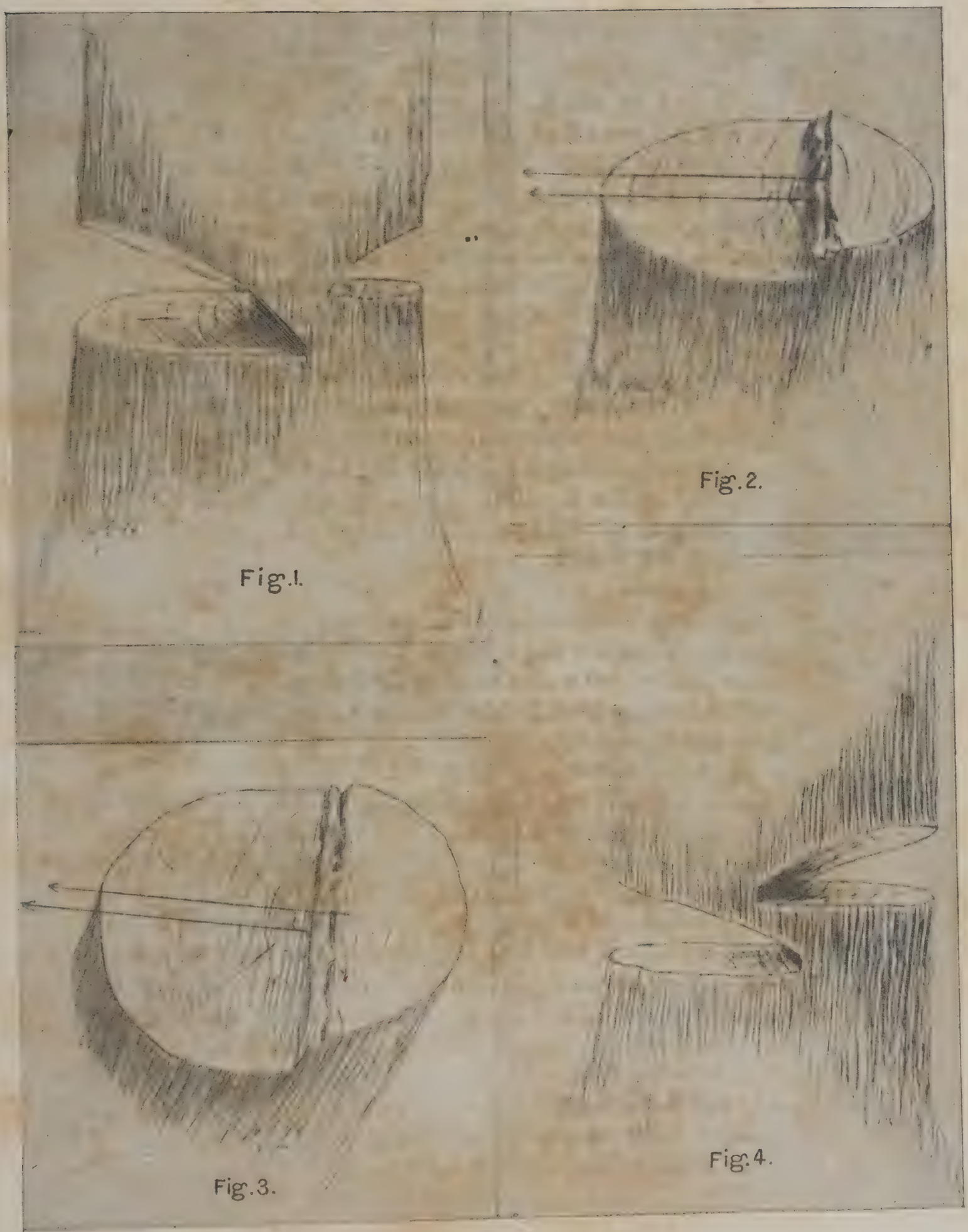

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

FELLING.

Fig.5.

Fig.6.

Fig.7.

Fig.8.

away from the higher level of the stool when the tree starts to move, which requires comparatively little strength. For instance, if a board be hinged to the floor and stood up against a box, it can only be pulled over the box with great difficulty and not at all without breaking either the hinges or the board; but a very slight touch will send it in the other direction. This is an exaggerated example of what happens in the case of the tree, but it exerts no small influence. If, on the other hand, the cut is made too high, it will be carried through too far, and will pass over parallel to the lower cut before the fibres break (Fig. 4), and the lower cut will have lost its use altogether; the weight now being thrown in the other direction, the tree will break at the upper cut. By cutting away the fibres underneath, the hinge has been destroyed and there is now no resistance to an upward pull.

If the two cuts have not been made parallel to one another and diverge at an angle, the tree is acting on two sets of hinges which direct it in different directions (Plate 12, Fig. 5); the one hinge may influence the tree to move due north, and the other 40 degrees away from it, and it consequently depends which of them is weaker, and breaks first, and the tree will not fall true. This is of great importance where there is a small gap with regeneration all round to protect. Similarly, if the cuts are made semi-circular (Fig. 6) there are hinges all round exercising divergent pulls, whilst the bulge of the rounded cut even acts as a wedge preventing the tree from falling in the desired direction, which it can only do when the cut is trimmed off straight (Fig. 7). It is a common fault to make the cuts curve outwards (*i.e.*, convex) on account of the difficulty of cutting in at the centre of the bole, whilst the sides are got at easily, and this requires particular care. I generally put my walking-stick up against the cuts to convince the feller of what is required. Making the cuts curve inwards (convex) would also be harmful, but it is difficult to do and the mistake seldom occurs. Another common error is to make the cuts slope away downhill, instead of keeping them perfectly level, and this requires constant correction (Fig. 8). This is caused by the weight of the axe drawing the hand down lower the further

it is swung from the body, while in making closer cuts the weight is not so great. The base of the tree is now placed on a slant on the fibres which are themselves slanting, and the tendency is that as the fibres snap when the tree commences to fall the butt will slip away on the downward slant of the stool, and alter the fall by several degrees.

I know I shall be severely criticized for condemning the saw and be told I am wasting 2 feet of timber; this economy is all very well with hardwood species grown on easy ground where the trees do not break up into several pieces on falling. A Deodar will break into fifty pieces and all splinter down so that there is no useful timber left. With care I can save with every tree felled many times what is lost by axing. It must be considered that I am felling trees with a bole of 100 to 120 ft. of useful, timber along hillsides of varying slope, on rocky broken ground, and I have, as far as possible, to make the bole strike the ground evenly throughout, to avoid breakage, as well as to protect the standing crop, and 1½ to 2 ft. is not much to sacrifice to these ends. A tree falling downhill swings through nearly 160 degrees; the great speed gathered as it swings almost through half a circle causes it to take a big jump away from its stump before striking the ground, and it slides a long way downhill before it is checked, doing great damage on the way, and breaking itself into many pieces. Trees when felled in this direction can more easily reach the tops of other trees, and do them most damage, and putting them so should be avoided. Cross felling trees one over another will cause them to break and slip away downhill, as they can get no purchase on the hard sloping boles of those already fallen, and hence all trees should be felled so as to lie as far as possible in one direction.

ANALYSES OF SOME MORPHOLOGICAL CHARACTERS OF BOMBAY WOODY SPECIES FROM AN ŒCOLOGICAL STAND-POINT.

BY L. J. SEDGWICK, F.L.S., I.C.S.

The idea of this paper originated from a desire to test the "drip-tip" theory of Stahl. The impression left on the mind of any one who peruses the œcological text-books is that the leaves of the tropical evergreen species have in almost all cases very long *caudæ*. The stock instance is *Ficus religiosa*. The long apical *cauda* was regarded by Stahl as a means of draining off the water, and thus avoiding the clogging of the stomata. Stahl called this *cauda* a "drip-tip," while Jungner introduced the word "rain-leaves" to indicate the caudate-acuminate tropical leaf form. These theories savour of the ultra-Darwinian principle of finding, in every character, a definite and advantageous adaptation to environment. The possibility of accidental characters, neutral characters, and characters which are the effect of environment, but are of no functional value to the plant was lost sight of. Moreover the stock instance of the "drip-tip," *viz.*, *Ficus religiosa*, is a rather unfortunate one, since this tree occurs widely throughout India, and is believed to be wild in the sub-Himalayan and Central Indian forests, regions which are not constantly moist, nor even exceptionally moist for long periods. It is also very problematical whether a long *cauda* would materially facilitate the keeping open of the stomata. If the stomata were closed by a very fine film of moisture, as for instance in the case of a leaf with a microscopically rough surface, the *cauda* would be ineffectual since it could not drain off water held by capillarity. While if, as is usually the case with evergreen species, the surface of the leaf is extremely smooth, polished, and even waxy, then the water will run off, whatever the leaf apex, except so much as remains as isolated and rounded drops. It was consequently a matter of interest to me, when I first saw the Kanara evergreens, to find that the "drip-tip" is by no means a very pronounced feature of

the forest, and therefore evidently by no means a necessity to the evergreen tree. Lately, it occurred to me that it might be of interest to make an analysis of the leaf-apices of all the woody species in the Bombay Presidency, with a view to ascertaining what forms are most prevalent in the main œcological divisions. The Bombay forests fall fairly naturally into evergreen, deciduous, xerophytic and maritime. Along with evergreen, I have included such deciduous species as are confined to regions of heavy rainfall. By "deciduous" I imply only the true "monsoon-forest." The dry deciduous of Gujerat, Badami, Gokak, and the Satpuras I have classed as xerophytic. By "maritime" I imply only those species that are definitely littoral, and not those which are typical of coast forests above sea-level. For the purpose of the analysis I have used Talbot's Forest Flora. I have excluded all species that are merely woody herbs, such as the *Acanthaceæ* or semi-herbaceous twiners, such as many *Asclepiadaceæ* and *Papilionaceæ* as well as low river-bed species such as the *Homonoias*. I have also excluded all those species which have pinnate or multi-pinnate leaves with very minute leaflets such as the *Acacias*. Species with compound leaves but large leaflets are included, the leaflets for the purpose of these analyses being treated as leaves, since they function as such. Only indigenous species are considered.

Pari passu with the analysis of leaf-apices, I made analysis of armature and methods of seed dispersal. These will be separately discussed.

I. Leaf-apex.

The analysis was not at all easy to make. A considerable number of species are recorded as having a variable apex. Such expressions as "acute or acuminate," "acute or obtuse," "obtuse or shortly and obtusely acuminate" are of constant occurrence. It was also very hard to decide whether to allocate a species to my class "very long acuminate" or to the next "gradually acuminate." Generally speaking, "very long acuminate" means a long *cauda* from a fairly obtuse apex. *Ficus religiosa* is not included as it is not a native plant. In the second analysis the classification is wider, and the personal equation is therefore reduced,

The percentages of this analysis given in No. 3 are of interest. While the very long "drip-tip" as a constant feature of moist regions is not established, it is certainly established that a fine point to the leaf is a feature of such regions, while an obtuse apex is typical of the xerophytes and maritime (physiologically xerophytic) species. But, for my own part, I should hesitate to agree that this phenomenon had anything to do with the necessity of enhancing or reducing transpiration. The simplest explanation seems to be that an acuminate leaf-apex is only the result of general good development owing to favourable conditions. The nerves of the leaf are a continuation of the vascular bundles of the branches, and the acuminate leaf-apex would only mean that these ultimate vascular bundles develop in length in excess of the lateral development of the leaf-blade. Of the very obtuse species occurring in the moist forest several are *Bauhinias*, whose peculiar leaves are possibly relics of a type which, in early ages, was more frequent. An interesting case of obtuse leaves in evergreen is *Carallia integerrima*, DC. (*C. lucida*, Roxb., in Talbot F. F.). The fact that this inland mangrove has a noticeably obtuse leaf-apex seems to imply that it has moved in from the coast, rather than that the other members of the family have been driven out into their present habitat. Its leaves, however, are often shortly and bluntly acuminate, though even so they are in general outline noticeably different from those of the other species around it.

II. Armature.

For the purpose of this analysis, I included the species with very minute leaflets which had been excluded from the analysis of leaf-apices, though still excluding palms, herbaceous twiners and shrubby herbs, as above described. The numbers of armed and unarmed species is probably fairly accurate. And the percentage of armed to unarmed in the different formations is roughly what would have been expected, *viz.*, evergreen 9 per cent., deciduous 18 per cent., xerophytic 35·5 per cent. and maritime nil. The absence of armature from the maritime woody species is, however, rather interesting, since maritime herbs show a common

tendency to become spinous. In the matter of armature I feel that ultra-Darwinian views have again been pushed to an extreme. It is often said that the reason for so many armed species in the dry country is that only those species have survived which rendered themselves immune to herbivorous animals by developing thorns. This is of very doubtful validity. Goats habitually eat *Acacia arabica* whenever they can get it, in spite of its formidable thorns. Camels eat *Alhaghi*. And I have myself seen a buffalo and her young calf burying their noses in *Spinifax*, than which nothing more formidable could be imagined. Nor have I noticed that monkeys show any disinclination to climb thorny trees. I have made a separate analysis of the details of the armature of the armed species. "Anomalous" includes mainly axillary and supra-axillary spines, the origin of which is obscure. The cases which I have classed as reduced branches in evergreen and deciduous are entirely in the genus *Flacourtia* which, as in the case of *Carallia* discussed above, suggests that *Flacourtia montana* and *F. latifolia*, Cooke, have moved into the moist region from the dry. Just as in the case of leaf-apex, so in the case of armature I feel that the phenomenon of thorns is simply due to the tendencies of general development. In the dry regions lignification and general rigidity of all parts is much more pronounced than in the moist. And the commonest organ in which this lignification sets in is the stipule. Next comes the hardening of the apex of the branchlet. This is very well seen in *Fluggea leucopyros*, *Gymnosporium montanum* and *Flacourtia sepiaria*, in which the so-called thorns continue to function as branchlets. Prickles are usually climbing apparatus, and are probably in origin developed from friction of the stem of the climber against its support. The anomalous thorns, very well seen in many of the *Rubiaceæ*, offer much greater difficulties.

III. Seed Dispersal.

The analysis which I have given of seed dispersal must be accepted with reserve, since the classification of mechanisms is even more difficult than that of leaf-apices. Probably a larger

number of the evergreen species have seeds adapted to carriage by water than I have shown. It was also almost impossible to decide which fruits are edible. As a matter of fact, I have given the benefit of the doubt in all cases to edibility. Those species which have dehiscent dry capsules with hard exarillate seeds, such as the majority of the *Euphorbiaceæ*, are put into the "unclassified" column, though there is no reason why they should not be eaten by birds. Again I was unable to segregate the "censer mechanism" of some authors, of which the *Aristolochias* would be a good example if their seeds were not also winged. The only percentage which it is perhaps worth taking is that of wind mechanisms (wings or pappus), the numbers for which to the total number of species gives evergreen 11·5 per cent., deciduous 17 per cent., xerophytic 19 per cent., maritime nil.

I. Analysis of Leaf-apex.

No. 1.

	Number of species.	Very long acuminate.	Gradually acuminate.	Abruptly and usually obtusely acuminate.	Acute.	Sub-obtuse.	Obtuse.	Very obtuse.	Plant leafless in mature states.
Evergreen ...	393	10	132	77	105	41	20	8	...
Deciduous ...	130	...	27	14	41	14	26	8	...
Xerophytic ...	94	...	9	5	19	13	25	14	9
Maritime ...	28	...	3	4	4	4	11	2	...

No. 2.

No. 3. Percentages.

	Number of species.	Acute or acuminate.	Sub-obtuse.	Obtuse.	Acute or acuminate.	Sub-obtuse.	Obtuse.	Leafless.
Evergreen	393	324	41	28	83%	10%	7%	...
Deciduous	130	82	14	34	63%	11%	26%	...
Xerophytic	94	33	13	39	35%	14%	41%	10%
Maritime	28	11	4	13	39%	14%	47%	...

II. Analysis of Armature.

	Number of species.	Unarmed.	Armed.	Class of armature.			
				Prickles.	Stipules.	Reduced branches.	Anomalous.
Evergreen	400	362	38	15	8	2	13
Deciduous	136	114	25	6	11	2	6
Xerophytic	108	69	39	5	18	7	9
Maritime	28	28	...	...	..	...	...

III. Analysis of Seed Dispersal.

	Number of species.	Water.	Wind.		Animals.				Unclassified.
		Floating or adapted to water.	Provided with wings.	Provided with hairs or pappus.	More or less edible.	Having bright arils.	Bright coloured without aril.	Provided with hooks.	
Evergreen ...	400	3	30	17	271	25	8	3	43
Deciduous ...	136	...	24	9	88	4	4	2	5
Xerophytic ...	108	...	11	9	71	3	2	1	11
Maritime ...	28	15	...	...	10	...	...	...	3

DEVELOPMENT OF LITTLE USED TIMBERS.

BY R. S. PEARSON, I.F.S.

One of the most important Utilization problems now to be solved is the best method of developing markets for timbers, other than those which find a ready sale. The subject falls under two distinct heads, *viz* :—(i) those timbers which are required for constructional and general purposes, and (ii) timbers employed for special purposes such as, for instance, rifle stocks, gun-carriages, turnery, tool-handles, carving, panelling, etc. By far the greater amount of timber will come under the first head, which will at the same time, generally speaking, fetch lower prices than that required for special purposes. The development of the markets for these two classes of timber must necessarily go on hand in hand, and if anything more attention should be paid to the former class, as the bulk of our output will be of that order. Of late, however, more attention has been paid to finding substitutes for European timbers for special purposes, and this was necessary under war conditions; then again it is a not unnatural tendency to aim at finding suitable timbers for special purposes, as if the interested person is successful, he quickly has the satisfaction of seeing some tangible result of his labours. We must, however, guard against the tendency to over specialize, and keep in view the main issue, namely, to find openings for the vast quantity of timber which will have to be placed on the market, as the working of our forests becomes more and more intense.

When attempting to place new species of timber on the market, the first point to be attended to is that it should be in a good condition and if converted, it should be of correct size, according to classes. This is, of course, well known by every Forester and Timber merchant ; the difficulty is to ensure that it is so, as the District Forest Officer has little or no time to attend to such duties nor has he, in many cases, the necessary plant of proper design in which to cut up the logs. To add to the difficulties, many of our Indian timbers are difficult to season, and require special attention, which all means expense and time. To

overcome this difficulty, several Local Governments are appointing Utilization Officers, who will be in charge of the development of both major and minor produce : they will also act as the Laison Officer between the Forest Officer and the Commercial World and translate result obtained by Research Officers into commercial propositions. It takes little imagination to realize the great importance of such Utilization Officers, or to realize that they too will soon find more work than they can well cope with, not to mention that the work of correctly cutting up, careful stacking and seasoning need not be carried out by so highly trained an officer.

To make the most of our timbers it will be necessary to convert them in properly equipped saw-mills, and to establish in connection with these saw-mills seasoning and storing depôts, in charge of a competent saw-mill manager. If such establishments are run by Government agency, they need not necessarily be large, and may only be of an experimental nature, chiefly aiming not so much at profit as in establishing markets for new varieties of timber, and storing timber against initial demand for special purposes. It has often been found that after favourable reports have been obtained on samples of timbers to be used for special purposes that the first large consignment has been a failure owing to there being no stocks in store and consequently unseasoned timber having to be sent, this means that a second order is not placed, and that a new market is not established.

In order to illustrate what may be done by careful seasoning, and also to show how timber may be damaged by incorrect methods, a few of the results obtained by carrying out a seasoning experiment are given below. The table illustrates the condition of the timber, when thoroughly seasoned, the percentages being based on the condition of each piece and by striking averages for a large number of specimens inspected.

Species.	Method of seasoning.	Percentages.			
		Sound.	Badly cracked.	Badly warped.	Insect attack.
Bassia latifolia ...	Seasoned in the log immersed in water for four months, then seasoned on land, converted and seasoned in the plank. Total period two years and six months.	29	71	...	...
Do. do. ...	Seasoned in the log without bark, under shade for 18 months and in the plank for 12 months.	48	52	4	...
Do. do. ...	As above, but with bark on	40	56	4	...
Do. do. ...	Logs converted green, planks seasoned in the shade, weighted above to reduce warp, for two years and six months.	83	15	2	...
Bombax malabaricum	Logs immersed in still water for four months, dried for 13 months in the log, converted and planks seasoned in shed for three months.	...	53	...	Heavily attacked by borers.
Do. do. ...	As above, but in running water for four months.	...	75	...	Do.
Do. do. ...	Green logs converted into planks, then immersed in water for four weeks, and dried in shed for 19 months.	93	7	...	...
Do. do. ...	Seasoned in log for 17 months, converted and seasoned in the plank for three months.	...	44	...	Riddled by borers.
Do. do. ...	Green logs converted and planks seasoned in shed for 20 months.	...	60	...	Heavily attacked by borers.
Dillenia pentagyna	Seasoned in the log, in the open, for 18 months with bark off, converted and seasoned in the plank for 15 months.	Both planks and rafters are rotten.			

Species.	Method of seasoning.	Percentages.			
		Sound.	Badly cracked.	Badly warped.	Insect attack.
Dillenia pentagyna...	Planks converted from green logs and seasoned in the open for two years and nine months.	Both planks and rafters all rotten.			
Do. do. ...	Seasoned in the log and immersed in water for four months, on land for 14 months, converted and seasoned in the plank for 15 months.	...	56	44	4
Do. do. ...	Trees girdled for 12 months, felled and converted into planks and seasoned for 21 months.	58	42	...	...
Do. do. ...	Trees girdled for 30 months, felled and converted into planks and seasoned for three months.	97	.	..	...
Do. do. ...	Seasoned in the log with ends protected, in one case with Tar and in other with Loracine, for from 12 to 33 months and then converted.	Both planks and rafters all rotten.			

Note :—In such cases where the various columns do not total to 100 per cent. the planks or rafters are either both badly cracked and attacked by insect, or are cracked and warped or a combination of all these defects.

The above are only three instances of the importance of attending carefully to the question of seasoning, but are considered sufficient to illustrate the great importance of this question. It will be noticed that no mention is made in the above record of experiments carried out in artificial seasoning plants, which methods, be if noted, are more applicable to seasoning timbers for special purposes though also in certain cases for constructional timbers.

As another illustration of more intense utilization of our hardwood timbers, some results may be mentioned which can be

obtained by careful cutting and quartering. Many Indian timbers are of an extreme ornamental character, and as such find a ready market: for instance, Blackwood (*Dalbergia latifolia*), Andaman Padauk (*Pterocarpus dalbergioides*), Walnut (*Juglans regia*), Marble wood, *Diospyros oocarpa* and others. Then, again, there are many extremely beautiful timbers which are little known, probably because their ornamental characteristics are not so self-evident unless the timber is properly handled. Thus *Tamarix articulata* which, in default of better timber in arid areas, is used for ploughs, Persian wheels and chiefly for fuel, if properly cut yields an extremely ornamental wood; *Populus euphratica*, which has no very high reputation as a timber, but like *Tamarix articulata* owes its importance to growing in arid localities, also when properly cut and seasoned yields a remarkably ornamental timber (Plate 13). Many other instances, such as *Cordia Macleodii*, *Soymida febrifuga*, *Quercus serrata*, etc., which are little known on the market, come under the same category. Then again, such poor class timbers as *Terminalia belerica* and *Sterculia villosa* have been proved to veneer well and make up into excellent three-ply boards.

The above instances will probably be sufficient to illustrate what can be done when careful and correct methods are adopted for seasoning, stacking and converting those timbers for which we have either to extend or create new markets. To carry out all these operations require much individual attention, staff and money, besides the necessary plant in which to convert the material, and also for the officer in charge to be in close touch with the market. It is thought that the best way of carrying out this work will be to establish Department Depôts in each province attached to a saw-mill, and to place them in charge of a whole-time man who will work under the orders of the Forest Utilization Officer. Not only would such an officer have every opportunity of studying and developing markets for timbers other than those now readily saleable, but such a depôt could carry moderate-sized stocks of timbers against demand for special purposes.

Panel of *Populus euphratica*.

SOME EXPERIMENTS CARRIED OUT WITH TREATED AND UNTREATED TIMBERS.

We extract the following information from a letter, dated the 30th December 1918, from the Deputy Conservator of Forests, Andamans, Port Blair, to the Forest Economist, Research Institute, Dehra Dun.

Nine pieces of Baltic Pine have been under observation since they were placed in position under the jetty between the log depôt and the swimming bath between high and low tide on 1st September 1916.

The three untreated pieces of Baltic Pine were rapidly attacked by toredo and for the last nine months have been falling to pieces at the base, the upper portions only still being in fairly good condition.

The six pieces of Baltic Pine treated under the Rüping Process (three pieces) and Dry Cell Process (three pieces) have apparently not been attacked at all and are still in good condition.

The two creosoted Gurjan (*Dipterocarpus turbinatus*) sleepers received from you, *vide* your No. 8871/45, dated the 30th June 1915, together with two untreated Gurjan sleepers were also put in position in the sea with the above Baltic Pine on 1st September 1916. The creosoted sleepers are still apparently intact, while the untreated Gurjan are completely eaten through at the base although not falling to pieces as in the case of the untreated Baltic Pine.

In addition to the above, I am making further experiments with Gurjan sleepers and other timber :—

two Gurjan sleepers were painted with *Avenarius carbolineum*,

two Gurjan sleepers with Solignum, and

two Gurjan sleepers with Jodelite.

One of each of the above was tarred in addition to being painted as a protection to the treating solution. These six sleepers together with an untreated Gurjan and one Gurjan sleeper tarred only, all properly labelled, were placed in position in the sea with the other timber on 8th November 1917.

The treated Gurjan sleepers are all apparently intact, while the untreated Gurjan has been riddled by toredo at the base. Similarly, I have painted three ladders made of roughly seasoned Pyinma timber :—

one with *Avenarius carbolineum* and tarred,
one with Solignum and tarred,
one with Jodelite and tarred.

Also one ladder made of roughly seasoned white Chuglam (*Terminalia bialata*) painted with Solignum and tarred. All the above have been labelled and are in use in the swimming bath, having been put in position on 17th July 1918.

OFFICE REFORM.

BY J. N. OLIPHANT, I.F.S.

Mr. Gibson's article, in the *Indian Forester* of June 1918, on the lack of up-to-date business office methods in the Department draws attention to a matter in which reform is sorely needed. At the present rate of expansion of forest activities reform will be forced on us before long, and it would be interesting if he would give us in greater detail his ideas as to the lines on which it should proceed. No immediate action seems possible owing to shortage of staff ; but when normal conditions are restored, there is no reason why officers should not be placed on special duty to study the question and propose remedies. Should it be decided to take such action, it is to be hoped that the mistake will be avoided of deputing for the purpose men who like office work for its own sake ; otherwise the remedy will be worse than the disease. On the other hand, wholesale scrapping of present methods is equally certain to do harm ; sound motives underlie most established procedure, and the need is for intelligent simplification rather than destruction.

Great progress has been made in the past year or two in obtaining Government recognition of the needs of the Department, and one cannot imagine any intelligent scheme of office reform supported by the higher forest authorities being turned down on the ground of the comparatively trifling expense involved. The

difficulty lies rather in finding men who can be spared to tackle an arduous and not particularly interesting job. No D. F. O. nowadays has much time to devote to improvements in office methods, which, in the first instance, until they have been established as routine, are apt to give more trouble than they eventually save.

It is not, I think, a mere question of obtaining modern office equipment. Such equipment is designed primarily for the use of commercial firms, and the systems to which it is accessory will probably need substantial modification to suit our needs. In the first place, the activities of the average business firm are much more specialized than those of the Forest Department; secondarily, there is necessarily in the department a large volume of internal or interdepartmental correspondence which does not admit of classification on the basis of the names of correspondents—the system most extensively used by commercial firms for correspondence with their clients. While name-indexing would be useful for a certain section of forest correspondence, *e.g.*, correspondence with contractors or having reference to individual employees, the greater proportion of it can be classified only according to subjects. It is my opinion that satisfactory subject-classification is the key to efficient organization of forest offices.

The system of classification for filing purposes in the circle to which I belong has been changed twice recently, so the question has been more or less forced on my notice; but I can sympathize with the reluctance of divisional officers in more restful localities, not to mention their clerical staffs, to stir up the dust of ages by an unprovoked attack on the system in being. But clouds of dust will have to be raised before any progress is made.

The history of the changes referred to in the preceding paragraph is perhaps worth recounting. The obvious need for reform of the mediæval system of correspondence classification in force prior to 1917-18 gave birth to a structure most carefully and logically worked out but unfortunately so formidable in its complexity as to reduce the clerical staff to a state of gibbering dementia. This was duly introduced in 1917-18. I fancy the majority of the executive after one agonized glance at the

document relegated it to their long-suffering offices for compliance and (its author having meantime been translated to a higher sphere) fell back in the following year with a gasp of relief on a classification borrowed from a neighbouring circle which Noah doubtless found exceedingly useful in keeping the books of the Ark. Such is the path of the reformer! The system superseded did not to my mind, deserve such a summary fate. Its chief fault lay in an attempt to prescribe too minutely procedure which should have been left to individual initiative; it also omitted necessary heads and included unnecessary ones.

The mistake made in all classifications of which I have had experience is that of prescribing too comprehensive file-headings. The average Indian clerk is not quick at association and cannot visualize the whole range of subjects that a broad heading covers. This is not intended in a disparaging sense—subject-classification is by no means as easy as it sounds, and filing clerks should really receive special training which, in present circumstances, they do not. My point is that clear-cut definitions are essential in a correspondence classification, and forest work is so extraordinarily varied that these cannot be obtained if the number of file headings is restricted within arbitrary limits. Such restriction, the motive for which is doubtless to avoid complexity in actual practice, defeats its own object.

When classification of documents has reached a reasonable stage of efficiency we can begin to think of abolishing correspondence register; at present, it is the only means of tracing misfiled papers, whose name is legion. With it could go the practice of serial numbering of individual letters, and their identification by case number and date, after the system adopted, apparently with success, for the correspondence of the Indian Munitions Board, could be introduced.

To turn to other points of office reform. The Standing Order, some time miscalled a guard-book circular, is an institution which has been much neglected. Anything of this nature which reduces recurring procedure to routine must obviously save clerical labour. The standing order system is often started and

then, owing to change of personnel, allowed to fall into disuse. Something should be done to ensure continuity, and guard-books of standing orders should be maintained both in circle and divisional offices. The individual orders should be arranged in a loose-leaf file according to the subject-classification in force. In a complex division it may be worth while, from time to time, to codify and print as a sort of range manual all the standing orders issued.

The memo. form of address should be made compulsory for all interdepartmental official English correspondence. It is appalling to contemplate the amount of paper, type and ink wasted in "having the honour to be."

Abbreviations should be used for all routine phrases (*e.g.*, copy forwarded for information = C. I.), and for terms constantly recurring in internal correspondence (*e.g.*, D. F. O.), Many officers have their own pet abbreviations, but these should be standardized and adopted generally.

Routine communications of a frequently recurring nature should be printed, cyclostyled, or multiplicated from type. This is not done to anything like the full extent that it might be. On the other hand, the extended use of stereotyped forms, must, if efficiency is to be maintained, be accompanied by some system of indexing and pigeon-holing which will render the required form immediately accessible to the issuing clerk.

Probably the first act of any business man tackling the problem of forest office reform would be the scrapping of our ponderous accounts system. There seems no particular reason why the bulk of divisional and range accounts work, and incidentally audit, should not be concentrated in a single office for each circle, with the adoption of an imprest system such as that employed by the P. W. D. Considering the large part of the year during which D. F.O.'s have to be absent from their head-quarters, they cannot be expected to keep their head offices up to the mark.

The establishment of telephonic communications, wherever feasible, should effect an immense saving of clerical work. Stenographers are an obvious need for heavy divisional charges, typist for heavy range charges.

Many other details suggest themselves, but this article is already long enough. In view of Mr. Gibson's remarks on the subject of camp clerks I had better confess to indulgence in three at times; the camp office, be it said, conducts practically the whole correspondence of the division—something over 15,000 receipts and issues annually when last I worked it out. But I deny having ever dictated letters in my bath: that institution is reserved for more choral activities.

EMBELIA RIBES—A MEDICINE FOR INFLUENZA.

BY C. KARUNAKARA MENON, FOREST RANGER.

Embelia Ribes—Tam. Vayivilangam—a climber belonging to the Natural Order "Myrsinaceæ" is widely distributed in the forests of South Kanara. Many have now recognized the medicinal properties of this forest product, hitherto unnoticed. It has proved to be a very effective medicine during the recent influenza epidemic in these parts. In many cases, a cure has been effected by taking decoctions of the root of this climber twice or three times daily.

There has been no failure in the case of any patient who regularly took decoctions of this when he began to feel the symptoms of this dreadful malady. In my case and in that of my family, it proved very effective. I distributed it widely amongst the villagers and my friend Mr. K. R. Guruswamy Iyer, Forest Range Officer, Coondapur, distributed it freely among the people of Coondapur town; and all those who used it acknowledged their indebtedness to us. People who used this as a preventive in villages where this dreadful disease played its havoc, were not attacked.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester*.

HYÆNAS AND WILD DOGS.

SIR,

Your readers must all have heard tales by forest tribesmen of how panthers and even tigers are sometimes hunted by packs of wild dogs, and of how panthers are sometimes forced to seek protection by getting up trees, but that they are there watched by the dogs until forced to descend by hunger or some other cause, whereupon they are caught, killed and devoured by the waiting dogs. Again, they must have heard that hyænas are afraid of panthers. I have myself seen a panther angrily drive off a hyæna which presumed to approach while he was feeding on his "kill." Incidentally it resulted in his death, for by so doing he came out from the shadow into the full moonlight and gave me a splendid shot.

Knowing this as regards the respect of panthers for wild dogs and hyænas for panthers, I was much surprised the other evening to see a hyæna again and again approach within five yards of a panther "kill" whilst wild dogs were feeding off of the scanty remains. Each time the hyæna approached he was driven off by two or three of the dogs, and was once knocked over, but only to return again. How long this would have gone on I do not know but, after ¾ of an hour or so, when it was getting dark, and I saw that the dogs would not go and the panther would not come, I shot one of the dogs with a charge of S. S. G. and dispersed the pack of dogs and hyæna, got down and went home. To what does the hyæna owe his immunity from the dreaded wild dogs?

H. W. STARTE,

Divisional Forest Officer, North Khandesh.

CHRISTMAS IN ASSAM.

SIR,—On the 26th December last I went on tour to Rajapara. On my arrival there I saw two of our contractors were waiting for me. I heard from them that one very big rogue tusker elephant was seen by some villagers in the morning, which badly chases even at the smell of a man. After I had my meal I started for Charaikhurung, a Garo basti in the Khasi Hills district. I had one Forester and one Forest Guard and the two contractors with me. Just when we got the path leading through our Reserve to Charaikhurung we saw fresh footprints of a big tusker elephant and we took the footprints to be of the rogue tusker which I was told of on my arrival at Rajapara and we were expecting to come across or be chased by it every moment. We made ourselves ready to face it and were climbing hill, slowly talking all the times various topics. Fortunately we came back safe in the evening not even coming across with a jackal. In the night we talked while busking and I went to bed after 11 P. M. on the upstairs of the subordinates' quarters. The quarters is a small two-storied planked bungalow with asbestos roofing, the second floor being about 12 ft. high from the ground level and the stairs contain 11 steps and a little unusually steep. Though unaccustomed with me I don't know why Heaven made me to bolt the door that night, with a wood stick kept standing against the wall near the door by whom Heaven knows. I awoke suddenly and heard something pushing against the door with hard breathing to thrust its way into the room, I was sleeping in. When a little conscious I understood it was a bear and that it was trying its best to open the door. Just at the time I heard a pony running in the compound below and one of the contractors, who were sleeping in one of the out-houses, came out shouting "Bagh," "Bagh" (tiger). The bear at once got down and took to its heels. I rose and looked to my watch. It was quarter past two. I came down with my lantern and knew that one tiger came and caught the pony of one of the contractors and the pony managed to get out of the jaw of the tiger which broke its neck

and ran in paroxysm to die falling in front of the D. F. O.'s bungalow. One bear which happened to come on roaming in the compound just then, met with the tiger and was so frightened that it ran upstairs to hide itself and was trying to push its way into the room I was sleeping in. The moon then rose and one of the Forest Guards sat on the second storey verandah of the D. F. O.'s bungalow with a gun and was waiting for the tiger to come back for its prey. It was in half an hour's time we heard a gunfire and were informed that the tiger came and just when it started with its prey, the Guard shot at it but as it was a buckshot he fired with, he could do nothing but wounding it.

J. M. BOSE,
Forest Ranger.

EXTRACTS.

PENCIL FACTORY AND TANSTUFFS.

[*Extracts from the Administration Report of the Department of Industries, Madras, for the year* 1917-18.]

Pencil Factory at Washermanpat, Madras.—The Pencil factory continued to work steadily during the year, and progress was made in many directions. The search for a suitable Indian wood for pencils was continued, and more than twenty different kinds of wood were tried. Unfortunately most of these woods had to be discarded, and for the last six months of the year the factory used exclusively cedar (*Juniperus procera*) obtained from British East Africa. Perhaps the most promising wood which was discovered was *Salix tetrasperma* from Travancore, but the tree is not very common or accessible and it has yet to be seen whether pencils made from the wood can be placed on the market at a remunerative figure. Arrangements have been made to experiment with the wood on a fairly big scale. *Rhododendron arboreum* and *Callitris rhomboidea*, both from the Nilgiris, seemed at first promising, but the former is unsuitable since it grows at high altitudes and the tree is usually small, gnarled and crooked.

Very good pencils were made from the latter, but when a bulk sample of the wood was obtained, the wastage on account of knots was so great that the pencils proved to be impossibly expensive. Pencils made from mahogany from Nilambur sold very well in spite of the porousness of the wood, but unless the Forest Department is prepared to provide the wood at very low rates, the pencils are not worth making. There is a steady demand for cheap white wood pencils, and I sold over 3,000 gross at an average rate of Re. 1-5-0 a gross or seven for an anna. But it is difficult to make a profit at this low rate, and my conclusion is that the factory should rely mainly on cedar from British East Africa. German, Austrian and English pencil makers rely mainly on imported cedar, and there is no reason why the Madras pencil maker should not do likewise. Collections of pencils made from the very numerous Indian woods experimented on were presented to the Forest Research Institute at Dehra Dun and to the Gass Museum at Coimbatore. A few more samples of graphite from the Northern Circars were tested, but it seems certain that the factory will always continue to get its graphite from Ceylon. Numerous recipes for colour lacquers were evolved, and a considerable improvement was effected in lead making. Last year only two sorts of leads were made, one for cedar pencils and the other for white wood pencils, but different leads are now made for drawing pencils, shorthand writers' pencils, and carpenters' pencils, while ordinary pencils with hard, medium and soft lead are also produced. Much work, however, still has to be done in this direction, and in time standard grades of pencils with leads of different degrees of hardness will doubtless be evolved. Perhaps the greatest success attained during the year was with copying lead pencils. Fancy prices were paid for methyl violet (Rs. 35 and Rs. 40 per pound), but even so the cost of the pencils was relatively small and they were eagerly bought up at very remunerative prices. In fact from the purely business point of view, I ought to have concentrated entirely on this class of pencil. From the ends of copying pencils after the pencils have passed through the end cutting machine this methyl violet is extracted and used for

making copy stamp ink. This ink is supplied to the Superintendent of Stationery. Blue and red crayon pencils were also made, and the former particularly were quite good. But it was not practicable with the existing machinery to turn them out in large quantities. In a larger factory where separate roller mills and lead presses could be set apart for pencils of this class it would pay handsomely to make them. Experiments have been begun with the manufacture of carbon brushes, and one of the Electrical Engineering firms has already placed an order with the factory for 360 dozen. Attempts were made to make crucibles for baking leads but they were not successful, and as experiments are now being carried on at the Bombay mint, the matter was not pursued.

Financial results.—The factory produced 12,626 gross of pencils in the year, and 12,222 gross were sold, the value of pencils sold being Rs. 33,498-6-4. A number of agents were appointed in July 1917, and the arrangements for the sale of the pencils were completed by the end of August. The following profit and loss account prepared by Messrs. Fraser and Ross, Chartered Accountants, who audited the accounts of the factory, exhibits the financial results of the industry in the seven months ending 31st March 1918:—

Profit and loss account for the seven months ending 31st March 1918.

	Rs.	a.	p.	Rs.	a.	p.
To Stock—						
Pencils ...	7,804	4	2			
Pencils in process ...	669	11	3			
Sundry materials ...	4,994	1	0			
				13,468	0	5
Stores purchases ...	10,759	6	9			
Wages and salaries ...	5,071	10	5			
Engine maintenance ...	1,190	8	8			
				17,021	9	10
General charges ...	75	7	9			
Repairs ...	3	9	6			
				79	1	3

	Rs.	a.	p.	Rs.	a.	p.
By Pencil sales ...				24,531	10	6
,, Stock—						
Pencils ...	7,534	14	1			
Pencils in process	556	6	8			
Sundry materials	5,551	13	10			
				13,643	2	7

		Rs. a. p.		Rs. a. p.
Experimental charges		424 0 0		
Packing charges		301 6 9		
Depreciation—	Ra. a. p.			
On Engine...	186 0 0			
On Pencil machinery...	361 0 0			
On sundry plant ...	76 0 6			
On buildings	386 0 2			
		1,009 0 8		
Profit for the seven months to date		5,871 10 2		
Total ...		38,174 13 1	Total ...	38,174 13 1

It will be seen that in these seven months the factory made a net profit of Rs. 5,871-10-2. The figure represents a good return on the comparatively small amount invested by Government in the business, but present conditions are of course peculiarly favourable for a pencil factory in India and an even larger return might reasonably have been expected. It should be remembered, however, that the factory was deliberately run on as small a scale as was consistent with demonstration on commercial lines, and a business firm which was prepared to duplicate the machinery, increase the output and push sales as they should be pushed wou'd undoubtedly make very much larger profits at any rate so long as the war lasts. Nor do I see any reason why the enterprise should not be a permanent success provided that the business is properly managed and capital put into it. At any rate Government have done enough in the way of demonstration. All the initial difficulties have been overcome, labour has been trained, Indian woods have been explored and useful experience has been accumulated. It is for private enterprise to carry on, and proposals with this end in view have been submitted to Government. Mr. Ramchandra Ayyar, the Sub-Engineer in charge of the Factory, deserves great credit for his energy, determination and skill. He is rapidly becoming an expert in all branches of pencil manufacture and has displayed great ingenuity in overcoming difficulties as they arose.

[NOTE.—The Forest Research Institute at Dehra Dun has tested a number of different woods with regard to their suitability for pencil-making and with the exception of *Juniperus macropoda*, no really suitable wood has been found. A pencil factory in Calcutta used this wood up to the commencement of the war and obtained supplies from Quetta side. Later the supplies were stopped for military reasons.

Cupressus torulosa has been used; it is, however, rather too tough and can only be classed as a second grade wood for this purpose.

Abies Webbiana is used in Calcutta in the production of cheap pencils.

The Small Industries Development Pencil Factory in Calcutta was found to be in full working order in December 1917 and was apparently carrying on a lucrative business. The wood they were using was chiefly *Juniperus procera*, which they obtained from British East Africa.—HON. ED.]

Controller of Tanstuffs.—The immense demand of the War Office for tanned hides, and the increase of production resulting from this demand and from the measures taken by the Indian Munitions Board brough into great prominence the question of supplies of tanning barks. Madras owes its prominent position in the Indian tanning industry mainly to the fact that the Presidency is prolific in *Cassia auriculata* known in Madras as *Avaram* and in the rest of India as *Tarwad*. The bark of this shrub is the great tanning material of Southern India. Its merits are that it is very easy to use and quick in its action, it adds weight and plumpness to the hides and produces a leather which is capable, after further treatment by the currier, of being turned to a variety of uses. The price of *avaram* rose very high owing to the demand for the bark, and the question became so pressing that eventually control was taken over supplies and Mr. R. B. Wood, I.C.S., was appointed Controller of Tanstuffs under the Indian Munitions Board.

Avaram supplies.—Obviously *avaram* bark will always remain the most important tanning material of the Madras Presidency, and the future of the tanning industry will always be bound up intimately with the question of cheap and plentiful supplies of the bark. This question has been brought to the notice of Government, and measures have been taken to encourage the growth of the shrub. But the question of substitutes has also come into prominence. It is being dealt with at the factory of the Esociet Company at Maihar which has been acquired by the Indian Munitions Board, but useful work has also been done on

new tanstuffs and mixtures at the Leather Trade School at Washermanpet.

Experiments with Black Wattle bark.—With the object of meeting the increased demand for tanning materials, the Indian Munitions Board imported a consignment of Black Wattle bark from South Africa, but it was considered inadvisable to distribute the bark broadcast to tanners until careful experiments had been made, and these experiments were conducted at the Leather Trade School by Mr. Kurup under the supervision of Captain Guthrie. Two sets of experiments were tried, some with wattle bark alone and others with mixtures of *avaram* and wattle in different proportions. Finally, a circular was issued to all tanners by Captain Guthrie recommending them to eke out supplies of *avaram* by using wattle bark with *avaram* in the proportion of 100 lb. of *avaram* to the first bark, and 70 lb. of *avaram* and 25 lb. wattle to the first and second barks. Wattle bark is now being used in quite a number of tanneries. It can also be used with Konnai (*Cassia Fistula*) bark.

Mr. Pilgrim's Visit.—Mr. Pilgrim, the Tannin Expert to the Government of India, whose head-quarters are at Maihar, was invited by Government to visit the Madras Presidency in order to investigate the resources of the Presidency in tanning materials, and with the permission of the Indian Munitions Board, he spent some weeks in the Presidency in September last. Advantage was taken of his visit to hold a small informal conference at which Mr. Pilgrim, Mr. P. M. Lushington, Conservator of Forests, Southern Circle, Captain Guthrie and myself were present. The tanstuff position was discussed. It was agreed that the most important thing to be done was for Government to organize the collection and distribution of *avaram* bark (a duty subsequently entrusted to Mr. Wood), but at the same time it was decided that in order to eke out supplies of *avaram*, experiments with mixtures and other tanstuffs should be begun at the Leather Trade School. A tour programme was also mapped out for Mr. Pilgrim, and it was agreed that he should investigate chiefly *Anogeissus latifolia*, the wattles and the mangroves of the Presidency. Mangroves

were studied in the Tanjore district and in the backwaters of Travancore. The mangrove swamps of Tanjore are well known, but unfortunately they consist almost entirely of *Avicennia officinalis* which contains very little tannin. In Travancore the mangrove has, in recent years, been displaced very largely by the cocoanut, but one swamp was discovered where *Sonneratias*, *Bruguieras* and *Rhizophoras* were common. All these mangroves are rich in tannin. *Anogeissus latifolia* was studied on the Kodaikanal ghat where a flush of young leaves was on. Bulk samples both of young and large leaves were powdered into sumacs and gave the following analyses:—

	Sample 1 (much red leaf).	Sample 2 (a bright green sumac).
Tannin absorbed by chromed hide powder ...	33·14	24·99
Soluble non-tannin	16·11	14·98
Insoluble matter	50·75	60·03
Moisture	...	...
Total ...	100·00	100·00

A sample purely composed of red (young) leaves gave the following results:—

Tannins absorbed by chromed hide powder	49·21
Soluble non-tannin	14·02
Insoluble matter	36·77
	100·00

It will be seen that the young leaves are very rich in tannin content, and very promising results have also been obtained at the Leather Trade School with twig bark. The tree is abundant in Tinnevelly, Madura, North Arcot, Salem, Anantapur, Bellary and Kurnool, and there should be a great future before this tanstuff not only for use in Southern India but also quite possibly for export. I was particularly anxious for Mr. Pilgrim's opinion on the wattles of the Presidency. All three species of the tree (*Acacia decurrens*, *Acacia dealbata*, *Acacia Melanoxylon*) are common on the Nilgiris and on the Palnis. The leaves contain tannin but the bark, especially of *Acacia decurrens*, the common wattle, is rich in tannin content. The tannin content has been found by Hooper

to be 25 per cent. in the upper stem bark, 33 per cent. in the lower stem bark and only 15 per cent. in the branch bark, but it has still to be decided by experiment whether better leather is produced by the stem bark or the twig bark, and experiments are to be made at Maihar to decide this point. Wattle bark from the Nilgiris and the Palnis should prove a useful supplement to *avaram* which will probably always remain the mainstay of the Madras tanners, but the question on which I wanted Dr. Pilgrim's advice was whether there was any chance of starting an export trade in tannin extracts made from wattle bark. The United Kingdom used to import extracts of wattle bark from Australia, and trade in these extracts is now springing up between South Africa and the United Kingdom. Mr. Pilgrim examined the wattle forests of the Palnis and found them to consist mainly of *Acacia decurrens*. Information supplied by Mr. P. M. Lushington, Conservator of Forests, Southern Circle, and the District Forest Officer of the Nilgiris, however, indicated that the quantities of bark available both on the Palnis and on the Nilgiris were not likely to exceed 200 tons a month and Mr. Pilgrim considered that extensive plantations would be necessary before an extract factory would become a commercial proposition. The question, however, has already attracted the attention of private enterprise. I had some correspondence on the subject and I understand that an application has been made to Government for land on concession rates for the purpose of forming plantations of wattle.

New Tanstuffs.—On Mr. Pilgrim's advice Mr. Rajamanickam Nayudu was deputed to Maihar to study the 'porridge' method of tanning, the object of which is to extract more completely the tannin in the tanstuff used. With the methods now in use in Madras, it may be noted 7 per cent. of tannin remains in the spent bark which is thrown away. A programme of mixture and other experiments was also drawn up with Mr. Pilgrim's help, and these experiments went on continuously at the Leather Trade School throughout the latter part of the year. Captain Guthrie kindly supervised them, but the experiments themselves were conducted by Mr. Rajamanickam Nayudu. The first series consisted of thirty

preliminary experiments on sheep skins with new tanstuffs either by themselves or in different mixtures. The new tanstuffs tried were *Anogeissus latifolia* red sumac, *Anogeissus latifolia* green sumac, *Anogeissus latifolia* twig bark, *Carissa spinarum*, *Xylia dolabriformis*, *Phyllanthus polyphyllus* and *Zizyphus xylopyra*. Twelve experiments were next tried on hides. They were not completed by the end of the year and were carried on through the vacation. The results belong properly, therefore, to the report for the current year, but it may be mentioned that particularly promising results have been obtained from the twig and trunk bark of *Anogeissus latifolia*, so much so that the Controller of Tanstuffs has already felt justified in arranging for the exploitation of this bark in large quantities by the Forest Department for distribution through the Government depôts to tanners. Printed vernacular instructions how to use the bark have also been issued. The bark of *Acacia decurrens* is also being freely issued to tanners for use with *avaram*, and so far every tanner who has used it has used it successfully. Red and green sumacs made from *Anogeissus* leaves are so strong that they cannot safely be issued at present to Indian tanners, but European tanners are ordering it in large quantities and appear to find it satisfactory. Further large scale experiments are being carried on at the School with Gottihar fruit (*Zizyphus xylopyra*), *Anogeissus latifolia* and *Carissa spinarum*.

MAKING PAPER FROM DEAD LEAVES.

Both in Europe and in America there has been a sharp rise in the cost of paper, and this has been peculiarly critical in France. Even before the war France imported half a million tons of paper pulp yearly from Austria and Germany, or about half of the whole amount used. The cutting off of the supplies from the Central Powers, and the severe deforestation due to the war have made paper pulp so scarce and so expensive that many periodicals have been forced to suspend publication. It is now proposed to make use of fallen leaves to supply this lack of raw material. On March 27th, M. Edmond Perrier of the French Academy of

Sciences presented before that body an account of the successful experiments along this line of Madam Karen Dramson.

The process is very simple, rapid and inexpensive; the leaves are first crushed, which reduces the blade to powder, which is carefully separated from the ribs and veins. It is the latter which form the raw material for paper pulp. They are subjected to a somewhat rapid lixiviation and are then washed and bleached, whereafter the pulp is ready for use. The leaf powder which remains is useful in two ways. It has a high food value, since it contains the digestible and nutritious parts of the leaf after the removal of the cellulose. As a food for cattle its nutritious value is almost equal to that of hay, especially when mixed with molasses and compressed into cakes. The leaf powder may also be used as a combustible. For this purpose it may be compressed into briquettes, either with or without being previously mixed with charcoal powder.

Madam Dramson recommends, however, the practice of dry distillation, by means of which she obtained a comparatively pure porous charcoal rich in calories (6,500 to 7,000 cal.), and easy to agglomerate. The process also yielded an excellent tar, having all the qualities of the so-called Norwegian tar, as well as acetone and pyroligneous acid. One thousand kilograms of the leaves yielded 250 kilograms of pure carbon (or 500 kilograms of edible powder), 30 kilograms of tar, one kilogram of pyroligneous acid and 600 grams of acetone. According to a recent estimate by the Director of the School of Grignon, France produces annually between thirty-five and forty million tons of dead leaves. It is calculated that only four million tons would be required to furnish the paper pulp required in an average year. The economic importance of the question is evident from the fact that in 1913 France paid $20,000,000 for the paper pulp imported from the Central Powers.

It is believed that the collection of the leaves can be done by women, children and war cripples. The leaves can be transported to the paper mills in compressed blocks, but it would be better to build factories on the borders of great forests so as to eliminate the cost of transportation.—[*Scientific American.*]

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THE BOARD OF FORESTRY, 1919.

TRIENNIAL MEETING.

The fourth triennial meeting of the Board of Forestry took place at Dehra Dun between the 31st March and 5th April last ; the members being Messrs. G. S. Hart, C.I.E., Inspector-General of Forests, ; T. R. D. Bell, C.I.E., Chief Conservator of Forests, Bombay ; C. G. Rogers, C.I.E., Chief Conservator of Forests, Burma ; B. B. Osmaston, C.I.E., Chief Conservator of Forests, Central Provinces ; P. H. Clutterbuck, C.I.E., Chief Conservator of Forests, United Provinces ; W. F. Perree, C.I.E., President, Forest Research Institute and College, Dehra Dun ; A. W. Blunt, Conservator of Forests, Western Circle, Assam ; R. McIntosh, Conservator of Forests, Punjab ; F. Trafford, Conservator of Forests, Bihar and Orissa ; H. G. Billson, Conservator of Forests, Western Circle, United Provinces ; S Cox, Conservator of Forests, Northern Circle, Madras ; F. L C. Cowley-Brown, Principal, Madras Forest College ; B. O Coventry, Conservator of Forests, Kashmir ; J. L. Baker, Deputy Conservator of Forests, Bengal ; and R. D. Richmond, Assistant Inspector-General of Forests.

The proceedings were opened by Sir Claude Hill, K.C.S.I., Member of Council in the Revenue and Agriculture Department, who gave the address reproduced below and who, up to the time of his departure on the 2nd April, took the keenest interest in the proceedings. This was followed by an address, also quoted verbatim, by the Inspector-General of Forests. The latter not only outlined the work awaiting the Board but reviewed the progress of research since the creation of the Research Institute and outlined the future developments required both in forest research and forest education.

The business of the Board of Forestry was then proceeded with. Committees were formed to deal with the programme of research work, thereby ensuring detailed examination of the subjects in consultation with the various experts. The programme after consideration in committee eventually came up for final consideration by the full Board. This method saves much time and discussion and affords more leisure for the special subjects and papers which have been set aside for general consideration. It must, however, be borne in mind that the Board is an advisory body whose functions are confined to the consideration of the Triennial Programme of Research, the conduct of forest education at Dehra and the discussion of technical matters previously approved by the Government of India. Its resolutions are laid before the Government of India who may invite the opinions of Local Governments on special points before passing orders.

In recording briefly the principal subjects that came up for discussion we take the opportunity of making a few observations which may help to elucidate the proceedings, and also serve to impress upon those who have not had the opportunity of seeing the papers or attending the meetings the main objects which underlie the recommendations made. To most forest officers the aims in view are obvious, but it may be useful to forecast some of the developments that are anticipated and to emphasize the necessity for the course proposed. Much of the ground has been traversed by the Hon'ble Member and the Inspector-General of Forests in their addresses, but too much emphasis cannot be laid on our urgent requirements.

In the strictly technical work of the department, and chiefly in the utilization and sylvicultural sections, we believe that the sectional meetings foreshadowed by the Hon'ble Sir Claude Hill will fulfil a long-felt want, as by frequent meetings in suitable localities, and not necessarily at Dehra, opportunities will be given to those who are chiefly interested of exchanging ideas and of introducing, into actual practice, methods and suggestions found to have answered in localities outside their own. It is obviously beyond the scope of the Board of Forestry to indicate anything further than broad lines of scientific or economic research, the details must be worked out by experts with the help of those responsible for carrying out the work on the ground.

The advantages of a preliminary discussion, prior to consideration by the Board of Forestry, were fully illustrated in one of the subjects, namely, "The methods of collecting and recording Statistical Information in sylvicultural matters" which had been dealt with at a conference held in July last at Dehra Dun. The Board accepted generally the recommendations of the conference which, as regards the compilation of yield tables, were explained in detail by Mr. S. Howard. The main feature of this discussion was the recognition of the necessity for decentralization of sylvicultural research, as it is obviously impossible for any central institution to cope with all the problems connected with tree-growth over a vast and varying country like India. While guiding and advising the local experts in their sylvicultural work, the functions of the Research Institute cannot go beyond the co-ordination and dissemination of the information collected by provincial experts. The debatable question of Forest Journals also came up for consideration, and resulted in the elimination, from existing headings, of much information already available elsewhere and the limitation of their function in future to the recording of facts and figures of actual value in the scientific and economic management of our forests. A more logical sequence of working-plan headings was also agreed upon, while the record of survey work entered in Forest Department Code Form No. 10 was also modified in the light of present and past experience.

Mr. Tireman's paper urging a large and immediate increase of Imperial and Provincial staff to cope with the immediate and future requirements of the Department resulted in the recognition that the service is much undermanned, although in present circumstances it is difficult to obtain trained probationers. The paper is suggestive of the huge possibilities of our forest resources, which require chiefly additional staff to develop them, and doubtless when this paper is circulated with the Board's proceedings will result in local Governments giving the matter their full consideration. Mr. Tireman was unfortunately not present at the meeting. Mr. Gibson's paper on Business Office Methods indicated means of adopting more modern and efficient methods of filing and disposing of correspondence than are usually adopted in Government offices. The principal criticism lay in the absence of a register of receipts and issues of documents which was held to be necessary. The subject is obviously one for detailed consideration by a small select committee composed of a few officers of the Department and one or two business men. In selecting the forest officers it will be necessary to guard against the mistake of selecting officers known to be partial towards office work. The duties of the forest officer lie in the field, and in the consideration of schemes for future economic development he should, therefore, be relieved of the unnecessary trammel of returns, reports, registers, etc., which form a feature of our present methods of office business.

Mr. Cowley-Brown's paper on Future Forest Colleges, coming at a time when the further decentralization of our ranger's education had been agreed upon, afforded valuable hints and conclusions The Madras Government, in placing an experienced officer of the rank of Conservator in charge of its forest college, has shown a just appreciation of the responsibilities attendant upon those entrusted with the training of our executive staff. We realize fully that the separation of the rangers' classes from the control of the Research Institute cannot take place too soon, as the educational work demands the closest attention and associated, as it now is, with research and the education of the provincial staff must result in loss of efficiency through sheer inability to devote the necessary attention to both interests.

The Board, in association with representatives of those interested in lac production, including members of Calcutta firms, an expert from Pusa, the Deputy Director of Commercial Intelligence and Director of Esociat Ltd., dealt with "Improvements in methods of cultivating and manufacturing Shellac." The chief obstacles to the introduction of the necessary improvements lie in the fluctuations of the lac market and the location of the principal lac-bearing areas outside Government control. It was, however, decided to recommend the conduct of experiments in improved methods of cultivation and collection in certain Government forests and to leave the question of further enquiry, if considered necessary, to the Department of Commercial Intelligence.

The formation of a special Forest Engineering Branch has been a long-felt want, and the resolution of the Board recommending the creation of a special Forest Engineering service, should go a long way towards the realization of the forest resources of India. These resources not only require improved methods of extraction, conversion and transport but an entire new agency to push the manufacture and marketing of existing and new products. The Board accordingly also dealt with the creation of this agency and it was unanimously resolved that new administrative units, styled Utilization Circles, should be established manned mainly by technical experts, to give effect to this policy, which in effect postulates new sources of revenue. In most provinces it will be necessary to establish pioneer factories so as to prove to capitalists that these undertakings are remunerative and also as an index of the terms on which leases or concessions can be made. Closely connected with the development of new forest industries is the supply of skilled workmanship and the Department should, therefore, be associated in schemes of technical education. The example of the United Provinces in transferring to the department the Government Central Wood Working Institute at Bareilly suggests an example that may usefully be followed elsewhere. Not only does such an institution afford means of training the necessary skilled labour but it advances

the solution of economic problems by covering the important stage of commercial research. In this stage articles and products must be manufactured in sufficient quantity to admit of tests under working conditions by consumers. Most wooden articles hitherto imported into India can be manufactured equally well in the country and the above policy all tends to render India less dependent on foreign countries—a policy which recent events have proved to be of paramount importance.

The establishment of sale depôts for Government timber at main business centres also came under review, and it will be interesting to watch the results of the agency recently established by the Government of India in Calcutta, and worked on a commission basis, for the disposal of timber from the Andamans and from other provinces who may choose to avail themselves of this opportunity.

In the matter of forest education it was resolved to recommend the admission of thirty students to the Provincial Forest Service course at Dehra Dun from April 1920 onwards.

It is useful to have an insight into the opinions of others on the relations of the department with the commercial world, and Mr. Raitt's paper reviewing present day treatment of applications from commercial interests was illuminating in affording us a criticism based on an insight of opinions gleaned from contact with both sides. The wheels of Government of necessity grind slow—and too often result in loss of opportunity. Mr. Raitt, therefore, advocated short-circuiting existing procedure by enlarging the powers of forest officers and empowering them to deal with such matters without the necessity of existing delays in Government offices. The suggestion has much to commend its acceptance. The Forest Department in at least one province has practically unlimited authority in such matters, and so long as the comforts of the local residents are safeguarded the interests of Government clearly lie in facilitating the attraction of capital for industrial enterprises. An important recommendation, which received unanimous support, was made by Mr. Raitt who advocated an early inventory of our resources so that interested persons

coul d, at a minimum of expense both in time and trouble, have all the necessary information placed before them. It was agreed that this valuable suggestion could best be entrusted to a small committee who would draw up a scheme outlining the order and the manner in which the idea could best be given effect to.

The meeting of the Board of Forestry thus dealt with a number of important questions which, if its recommendations are accepted, should go far towards important scientific and economic developments. The cry is, however, first for staff, and still more staff, and the set-back caused by the unavoidable cessation of recruitment of Imperial probationers during the war will put back the expansion along scientific and economic lines which the country now stands in the greatest need of. Delay must spell loss of opportunity and we, therefore, trust that no effort will be spared or money stinted to make up for the time lost. The figures of our finances, quoted in the Inspector-General's address below, are indicative of the value of India's forest resources but, as Mr. Hart points out, they are insignificant in comparison with the vast possibilities still untouched. The Forest Department has hitherto been occupied chiefly in creating and organizing a forest estate adequate to the requirements of the country. It has also given a full measure of attention to the restoration of forests which usually have come into its hands in a ruined or semi-ruined condition. The process of restoration has resulted in a multiplication of the value of the forest capital which few have appreciated or even thought of. The time has now come for the realization of the interest on the enhanced capital. To achieve this, scientific and economic expansion must keep place with increased production. The small staff, indifferent equipment and inadequate accommodation at Dehra Dun will require immediate expansion so that research can be securely established and problems dealt with as they arise. It must also be conceded that the provinces must take up their own responsibilities in this direction and employ their own research officers in sufficiently mportant problems. Moreover, we must exercise foresight and even allow free play to our imagination so that we shall not stand

charged by our successors with lack of appreciation of our responsibilities.

The meeting of the Board of Forestry in 1919 marks one of the most important stages reached in the history of the department. We must either move forward or fall back, we cannot remain stationary. Our chief difficulty lies in convincing others that immediate action is necessary, and however fully we ourselves are convinced of the righteousness of our cause unfortunately we do not always carry conviction with us. Our predecessors have achieved great things in the face of powerful opposition, and our duty lies in redoubling our efforts until we carry conviction, as they did for us. Too much time is now taken up in meticulous detail and criticism with a view to avoiding mistakes. The only safe way of avoiding mistakes is by doing nothing at all. Delays in disposal of forest affairs are almost as formidable as a negative reply as they effectually destroy all interest. By frequent contact, interchange of views and ideas in the manner indicated by the Hon'ble Member in his address, we shall be in a position to present a united front and this will not only serve to carry conviction but will go a long way towards the achievement of the policy of advancement which the department is fully convinced of the necessity for and is eagerly looking forward to.

Address by the Hon'ble Sir Claude Hill :—

"MR. HART AND GENTLEMEN,—It affords me the very greatest pleasure to be here to-day and to have the opportunity—I fear the only one I shall have during my term of office—of attending a meeting of the Board of Forestry, and to make the acquaintance of such of you as represent the provinces here to-day. It is to me a great misfortune that your Board of Forestry only meets once in three years instead of, as in the case of the Board of Agriculture, every other year, for I have seen enough of these meetings to appreciate the very great value which they possess, not merely from the point of view of the results of deliberations—though these are invariably of the greatest possible value—but also in connection with the opportunity it affords to officers prominent in their provinces to exchange

ideas generally with fellow members of the service serving in other provinces and those at this Institute. I have perhaps particular reason for appreciating the value of such interchange of ideas, since I come from one of the two provinces, Madras and Bombay, in which there is a greater degree of self-continence in forest operations. That greater independence is a feature which will increase and develop gradually in the other provinces in India as provincial autonomy increases, but for that very reason the value of such meetings as these is all the greater, and I feel confident that, as provincial autonomy does develop hereafter, it will be found so increasingly desirable to give opportunities for exchange of ideas and information that, instead of having your meetings once in three years, they will, as in the case of the Board of Agriculture, take place at least once every other year. It is perhaps not wholly irrelevant to this subject to refer to the great isolation which characterizes so much of the life of a forest officer, and in all cases in which work is done over long periods in such circumstances there is an additional advantage in convening meetings for discussion. Isolation and concentration on a particular line of work is always apt to induce specialization of thought and sometimes intolerance of view; not that I wish to suggest that that is characteristic of forest officers, since that is very far from being my experience; but I know from my own experience that work on special subjects in lonely conditions tends to narrowness of outlook, for which, so far as my experience goes, there is only one remedy, and that is, rubbing shoulders with others engaged in similar work. This perhaps is an additional argument in favour of more frequent consultations in regard to forest work.

"While I am on this subject, I should like to give you one result of our experience in this matter in the case of agriculture. There we have found that a Board meeting even once every two years is wholly inadequate for the purpose of getting through the work of exchanging ideas, discussing developments and formulating schemes of advance. Indeed, the work three years ago before the Board of Agriculture was so heavy that we were forced into

recognizing that the time had come for inaugurating sectional meetings annually. These sectional meetings, which have enabled specialists in particular lines to meet and discuss their problems, have not only proved of the utmost value to research—whether mycology, entomology or chemistry—but have relieved the Board of Agriculture of no inconsiderable volume of work. I am not quite sure how far the analogy in the Forest Department holds good. It is obvious, of course, that where agricultural research in the provinces is more organized and developed than is the case with forestry, the need for such sectional meetings is more imperative but, even in forestry, you have already sylviculturists everywhere who should certainly meet as frequently as possible, and you will shortly have forest engineers in no inconsiderable number; and the development of utilization work will, unless I am very greatly mistaken, compel you to have frequent meetings of your forest economists and utilization officers.

"Before proceeding to other matters, I should like to mark this occasion, being the first since the conclusion of hostilities, by a reference to what the Forest Department has contributed directly in manhood towards the war. 73 Imperial Service officers and 13 Provincial Service officers were permitted to join the Army or accept employment on war work of other kinds. A great many more desired to join up, but this could not be permitted if the work of the department was to be kept going and if the supply of produce for the requirements of the Army was to be maintained. Several military decorations have been earned by our officers but we have unfortunately also to deplore the death of 8 young members of the service, namely, Messrs. Patterson, Alington, Jeffrey, Ellis, Dickson, Gwyer, Donald and Milne, all of whom, except the last two, who died of disease, were either killed in action or died of wounds. 8 Imperial officers also were wounded. And, gentlemen, if I may say so, those who remained behind in India and who have shouldered the burden of the past four years with a depleted staff and an ever-increasing demand on them for work have equally served their country well. Few people appreciate what the additional burden of work has been, whether in the

forests, Public Works or other service in this country, though we all realize the hardship that has been involved in so many cases in being debarred from the taking of leave. I can assure you, however, that the hard work which has been done by all of you so uncomplainingly and cheerfully has been very greatly appreciated by Government.

"I want now to turn for a moment to a matter which is of vital importance to the future, namely, the schemes which are in hand for the enlargement and development of the Forest Research Institute. That Institute is partly concerned with educational work as well as with research. The matter was first considered at an informal meeting about a year ago in this room when we discussed the possibilities of expansion and the general needs of the situation. A committee also discussed the matter last July and drew up a comprehensive scheme which was designed to meet not only immediate requirements but, so far as they can be foreseen, to suffice for the inevitable expansion of the future, especially in relation to research and commercial development. That scheme, which has been referred to local Governments, has not yet been elaborated to a stage when the sanction of the Government of India can be formally secured. It contemplates a considerable strengthening of the sylvicultural branch, a development and division of functions of the botanical branch, the inauguration of regional entomologists, and, under the forest chemist, the appointment of a soil chemist and a distillation expert. On the economic side, we propose to strengthen the forest economist's branch by an assistant, a wood technologist, a minor forest produce expert and experts in subjects such as pulp, tan stuffs and dyes, etc., though some of these may not be permanent appointments. As Mr. Hart will explain to you in greater detail, it is further proposed to modify the administration of the Institute by inaugurating a Council consisting of the President and the heads of branches more or less on the lines of the organization which we have found to work on the whole successfully at Pusa. This development we hold to be justified not only from the point of view of research, in which so much lee-way has to be

made up, but also from the point of view of the educational needs of the Institute. In regard to education I am not in a position to ay so much as I could wish, as things are still at the stage of deliberation, and a very great deal must depend upon what this Institute is in future to be expected to do in the way of education. As you are all aware, in future we hope to arrange to secure that Indians with the requisite qualifications will be associated in forest work in the Imperial Forest Service, and I know that you will all agree with me that in this matter the Forest Service and the forest administration, which we are developing for the benefit of India at large, should be shared with Indian gentlemen of the right stamp. I do not propose here to give a dissertation upon the proposals of the Public Services Commission but it is necessary that I should say that, provided we can find Indians with the requisite qualifications willing to enter the Forest Service, it is our business to arrange for their proper training. The matter presents unusual difficulties in the case of the Forest Service inasmuch as Indians have hitherto, for one reason or another, shown no special desire to undergo a forest training presumably because other lines of service have proved to be more attractive to them. One question of vital importance in the future will be what is the best arrangement for securing the training of our forest officers of the future, whether Indian or British. I think all will agree that training should take place at one place, that all should be trained together, whether it be in England or in India ; and the conditions and circumstances governing such training is a matter of very great importance, regarding which a decision has not yet been reached. So long as there is a possibility of its being decided that such training should take place in India, it will be realized that the contingency is one which has to be borne in mind in reference to the organization of the Institute here, which is the only possible place at which such training could take place outside the United Kingdom. As I have said, that matter is still under consideration. It is one of the many problems arising either directly or indirectly out of the recommendations of the Public Services Commission regarding whose recommendations, as I have said, I do not propose

to detain you with any remarks to-day, since I know the Inspector-General is going to refer to the matter.

"It will be realized from what I have already said that the development of research is one of the subjects to which the Government of India attach the very highest importance. It cannot be for a moment pretended that we are in that respect adequately equipped or staffed but it may perhaps fairly be claimed that it is only of comparatively recent years that it has been understood how important research is to forestry and to the exploitation of the enormous forest resources of India to the best possible advantage of the State. In regard to sylviculture, indeed, it may be said that we have made a beginning, but, from the account which Mr. Hart will give you of the history of this Institute, I am afraid it must be admitted that it is only during the past few years that adequate recognition has been given of the need for higher research in chemistry, entomology, botany and so forth. It is because we are coming to realize the importance of this that we have been considering the urgent needs of the moment in the way of increasing our equipment and accommodation; and to those of you who are here and who have not seen it before, I would suggest that, while in Dehra Dun, you should ask to see the scheme of development which we have under consideration, since the more opinions we have on the subject and the more suggestions that are made, the more likely are we to deal adequately with it and to secure the understanding and sympathy of the department and local Governments.

"I am the more anxious to make clear that in forestry we recognize the need for scientific development in that we are simultaneously taking what we hope will be considerable strides in advance in science as applied to agriculture and industry generally. I dare say many of you have read Sir Thomas Holland's Industries Commission's report and have seen the suggestions which have been made for co-ordinating research generally. We have recently been considering at Pusa the developments which should result there from this movement towards closer co-ordination of research and it has been recognized by the scientists working

there that there is a great deal to be said for closer co-ordination of all allied scientific work, even though specialized under different heads. For example, botany, whether it is agricultural botany or forest botany, and entomology, whether forest or agricultural, must necessarily work in so closely together as to make it almost inevitable that there should be some co-ordinating directorate.

"To those of us who are in a hurry, this perhaps is a misfortune. We should all like to see results quickly but I venture to believe that research officers generally will recognise, even if the public do not, that, when we are endeavouring to establish scientific development upon a really sound basis, it is perhaps better to go slow at the beginning rather than to take hasty steps in advance which may have to be retraced. Let me give you an example of what I mean. At our Agricultural Institute at Pusa, we are contemplating, as here, an advance in our botanical and mycological section. If we were looking at agriculture and agricultural botany and mycology alone, it would be easy enough to build the necessary additional laboratories and to engage the necessary additional staff and the thing would be done; but there are factors in the case which necessarily make one pause. It has to be considered firstly, whether for those particular sciences the situation of Pusa is the best possible, or secondly, whether the desirability for co-ordinating research, say, in botany, might not make it desirable to bring agricultural and forest botany into closer contact. It is perhaps preferable to delay progress by a little to thresh out these doubts rather than to go ahead ignoring their existence.

"Turning now to more practical matters, I think you will realize from what the Inspector-General will shortly tell you that considerable progress has been made on the utilization side in the last two or three years. The war has afforded us a stimulus for development of forest produce which has not been neglected and, if anything had been required to hasten the much-needed introduction into India of a staff of forest engineers, the war would have provided the stimulus. I look forward to the time when every

province will have its staff of forest engineers and, as I have already said, when there will be meetings of these at frequent intervals to concert further developments. This alone, coupled with the work of a developed forest economist's branch, can remove the reproach that the low return which we at present get from our forest area in India compares so unfavourably with the corresponding returns of other countries.

"I did not intend to detain you for so long as I fear I have done, since I know you want to get to work and Mr. Hart has a great deal to say to you, but I did want to make it clear that the Government of India attach the very greatest importance to deliberations by the Board of Forestry and that they believe that your discussions will help them very greatly with advice and guidance in steering a course towards more efficient development.

"There is one more point to which I should like to refer. I have read with interest a note by Mr. Pearson, dated the 28th of February last, on the dissemination of information by the Forest Research Institute. Now, as I have so often had occasion to observe before, all Governments, except possibly the more democratic governments of the antipodes, are bad advertisers, and, of all bad advertisers, the Government of India and their allied officers are the worst in the world. Whether we do good or not may perhaps be questioned, but, if we do good, it is certainly by stealth, and, in these days of political reforms and democratic developments, it is no longer permissible to hide our light, if we have any, under a bushel. Here, in this Research Institute—and of Pusa the same tale is told—the results of our investigations and research are so badly advertised that the man in the street questions whether we have any. Mr. Pearson has rightly looked at the matter from a commercial stand-point. After all, our results are intended all the time to produce commercial advantage and we are not doing the whole duty of man unless we attain a certain degree of publicity. It was therefore with very great pleasure that I approved the other day the proposal to issue periodical leaflets an to take the other steps which Mr. Pearson advocated."

Inspector-General's Address :—

"SIR CLAUDE HILL AND GENTLEMEN,—Before proceeding to review the results which have followed the last meeting of the Board in 1916, I wish to express my thanks, in which I know you all join, to Sir Claude Hill, the Honourable Member in charge of the Department of Revenue and Agriculture, for the trouble he has taken in coming to open the fourth meeting of the Board of Forestry on the eve of his departure on leave and for the very interesting address to which we have just listened.

"All of you are familiar with the action taken by the Government of India on the recommendations made by the last Board of Forestry and there are only two points to which I need draw your attention :—

(*i*) We shall discuss again the question of a forest engineering branch of the service. In the meantime I am glad to be able to tell you that considerable progress has been made in dealing with this important subject. Most local Governments have recognized that men of this class are required and have asked for one or more of them. As you are probably aware the Government of India deputed Mr. Leete to study the forest engineering methods employed in America and Canada. In addition to being a senior officer of great experience, Mr. Leete has devoted great attention to matters connected with forest engineering throughout his service and so was particularly suitable to carry out this enquiry. His report, which is a very valuable one, has been received, and the first portion of it is now in proof, while as the result of one of his recommendations the Government of India have asked the Secretary of State to engage for them two consulting forest engineers from America for a period of two years, extendable to three if desired. These consulting engineers will advise the Government of India and local Governments on forest engineering problems and will help

in starting off on the right lines the dozen or so junior forest engineers who, it is hoped, will shortly be recruited and distributed amongst provinces after a period of special training.

(*ii*) In educational matters the position as regards the Provincial Service course has been much improved by the acceptance by the Government of India of the recommendation made by the last Board for the appointment of two Assistant Instructors. For this course we have now two Instructors and two Assistant Instructors, so that, with the research officers delivering short courses of lectures in their special subjects, it is now possible to maintain the standard of instruction at a high level. This is not altogether the case with the Rangers course, which for some time past has been short of one instructor, as the number of officers who have joined the Army and the cessation of recruitment have made it impossible to obtain an officer for this post. The reduced staff has done its best, but there is no doubt that each of the large Ranger classes must have an Instructor and an Assistant Instructor if the teaching is to be kept up to the standard required.

"In addressing the Board three years ago I referred to the question of decentralizing the training of Forest Rangers and expressed the opinion that the scheme would have come into force by this time. The necessity for the curtailment of expenditure caused by the war and the uncertainty as to the arrangements for the future training of recruits for the Imperial branch of the service have prevented this. But decentralization will be introduced to some extent next year, as from 1920 Ranger students from the Central Provinces, Bihar and Orissa, and the Central India States will go to the Madras Forest College at Coimbatore. This will enable the Dehra College to take more students from the other provinces, until the Government of Bombay can construct the proposed Forest College at Dharwar, thus permitting the scheme of decentralized training to be introduced in full.

"One hears from time to time, Gentlemen, whispers to the effect that the department as a whole does not know very much of the work done by the Research Institute. I think, therefore, that it may not be out of place if I give you a short sketch of the principal work done since forest research was first commenced.

"Work in the Chemical branch was started by Dr. Warth in the nineties, and some ten years later a second and more serious attempt was made, though the lack of accommodation and appliances limited the scope of the work to the chemical valuation of materials submitted by various officers and departments. The provision of a laboratory and equipment in 1914 gave the Chemist an opportunity of proving the value of this branch. The demand for analytical work has steadily increased and left the relatively small staff little time for original work. Nevertheless a good deal of investigation has been carried through with the main object of demonstrating on a commercial scale, the possibilities, or otherwise, of developing certain industries. It is possible only to mention a few of the principal investigations. These comprise tanning extracts, chiefly in relation to mangrove bark, and the distillation of turpentine from the resins of Indian pines, resulting in the introduction of the redistillation process in our present distilleries. The possibility of pine needle oil has been fully investigated while the chemical properties of the natural varnish of *Melanorrhœa usitata* have been proved to be identical with Japanese lacquer varnish. The first researches into the manufacture of Thymol from "Ajowain" seeds were made at this Institute and have resulted in the erection of a factory in the Dun which now supplies a large part of the world's requirements. Latterly the manufacture of turpentine, rosin and gum from the gum-resin of *Boswellia serrata* has been investigated and this will, it is hoped, yield important results. A very large number of other minor investigations have been carried out; their number may be gauged from the fact that 57 notes and reports have been prepared, the majority of which have been published. These results must be considered creditable in view of the small staff and the inadequate equipment at our disposal. The Zoological branch was

the next to be started by the appointment in 1906 to the Forest College staff of an Entomologist for educational and research work. Although the title was later changed to that of Zoologist, in point of fact the work has practically been confined to entomology. This work may be divided into three distinct periods. The first from 1906 to 1911, when a general survey was carried out, resulting in the discovery of a large and complex fauna. Scientific research was, however, hampered for want of literature, equipment and authoritative identification. Much general work was taken up though little specialization was possible. Of 34 publications issued to date, no fewer than 26 appeared during this first period. The second period lasted for some two years only; but in it valuable reforms were inaugurated and provision was made for the fundamental requirements of research, comprising a reference collection named by specialists, an extensive library and adequate laboratory and insectary equipment. Valuable investigations were made into the lac insect, the chir scale and the principal borers of Sal, while an extensive collection of termites was gathered in all forest divisions; this last material is being utilized for the volume of the Fauna of India dealing with this group. The third period, which brings us to the present time, has revealed that the most productive methods of investigation lie in the consideration of the forest as a biotic association of plants and animals and in the treatment of insects from an œcological standpoint. In considering the œcological position of forest insects on broad lines it was determined (i) that Indian forests are not subject to epidemics under normal conditions, but (ii) that conditions favourable for epidemics and the evolution of new primary pests may be created by the establishment of pure plantations and uniform forests. Thus the large pine bark beetle and its associates, and the 'toon' shoot and fruit borer seem to be results of artificial methods of regeneration. Pests of the natural forest such as the heart-wood borers of *sal* and teak and the defoliators of this latter species have been worked out, but such enquiries necessitate the investigation of a complex association of insects and their alternative food plants. Investigations of this kind are therefore

prolonged and remedial measures are not easy of solution or application. The collection of insects has made good progress and now contains 8,000 species. The number of specimens cannot be calculated but about 12,000 are added each year of which fully half are bred in the insectary. The museum and library have expended steadily while there are some 5,000 ledger files. Card indices have been prepared for Indian insect species, food plants, pests of trees, literature, etc.

"In the Botanical section, which started with the creation of the Research Institute in 1906, the work falls under the main heads of education, systematic botany, diseases of trees, and œcology. The educational work has included the publication in 1909 by Mr. Hole of an excellent manual and the botanical work of past students indicates that the teaching has borne good fruit.

"Systematic botany has had for its principal object the dissemination among forest officers and economic workers of a good knowledge of the names and economic uses of forest species, firstly by encouraging the publication of floras and descriptive lists, of which several have been issued by local officers and several more are under preparation, and secondly by identifying specimens for enquirers. For satisfactory identification work a good herbarium is essential as well as a well-equipped library, and since 1906 more than 20,000 sheets have been added to our herbarium, in addition to Mr. Duthie's valuable collections incorporated in 1908. Since 1908, 4,100 specimens have been identified for forest officers and others, and this work has resulted in the discovery of a number of new species, among which may be mentioned species of *Albizzia*, *Spodiopogon*, *Hopea*, *Ixora*, *Grewia*, *Eugenia* and *Tamarix*.

"In dealing with diseases of trees it has been established that the *Trametes Pini* of the Blue pine is conveyed by spores alighting on wounds and can be controlled by the prevention of lopping. As regards the spike disease of sandal, the Forest Botanist has suggested a line of enquiry that may give good results. In œcology the most important work comprises a long series of experiments on the factors influencing the growth of seedlings and has indicated a method of working the *sal* forests of Northern

India which, it is estimated, will reduce the regeneration period by some 35 years.

"The importance of soil-aeration, which is now recognized in England and America as a potent factor influencing plant growth, was first brought to notice in India by the Forest Botanist.

"The work, which has been carried out with the help of the Chemical branch, has established the primary importance of this subject in the case of *sal* and probably of other important trees also, and has proved that it can be controlled by suitable sylvicultural treatment: it indicates, also, that the control of the root diseases of *sissu* and *sal* probably lies in the improvement of the soil conditions in the moist type of forest in which these diseases are mainly noticeable. This work, therefore, is of great importance to Indian forestry. Many valuable investigations have also been made, among which may be mentioned those regarding the various types of grassland in their relation to tree-growth, the method of working grasses for paper-pulp, the germination of teak seed, and the seasonal coppicing of this species. For much of this work the department is indebted to Mr. Hole who, with intervals of leave, has held the post of Forest Botanist since 1906.

"When the Research Institute came into being in 1906, Sylviculture and Working Plans were constituted as separate branches. A Superintendent of Working Plans was appointed at once, but the post of Sylviculturist was held successively by the Principal and by the Superintendent of Working Plans, in addition to their own duties, with the result that little or no progress in Sylvicultural work was possible until 1910, in which year a satisfactory start was made in systematic research work. The Sylviculturist's work is partly statistical and partly experimental; in addition all available information bearing on Sylviculture and forest management is systematically classified and recorded and no small amount of the Sylviculturist's time is occupied in supplying officers of the Forest Department with information and advice. Since 1910 altogether 293 permanent sample plots and 74 temporary plots have been laid out and measured, many of them twice. The permanent plots, which are situated in the

Punjab, the United Provinces, Bengal, Bihar and Orissa, the Central Provinces and Madras, are re-measured quinquennially : their object is to ascertain the rate of growth, volume production and intermediate yields of typical forest crops of different kinds. Experimental work is carried out in the Kaunli garden, 10 acres in extent, at Dehra Dun, while a great deal of the earlier preliminary work was located in the Surajbagh garden, afterwards abandoned in order to make room for the Research Institute buildings and grounds. Apart from garden experiments, however, there are numerous experimental plots in the forests which are visited periodically with the view of recording observations. Regeneration fellings on a practical scale, as applied to the *sal*, are studied in the Thano forest in the Dun, which is under the management of the Research Institute. The results of Sylvicultural research must necessarily be slow in appearing, since it is frequently necessary to continue experiments for many years before definite results are obtained. Among the published work of the Sylviculturist may be mentioned a monograph on *Pinus longifolia*, notes on the Blue Gum Plantations of the Nilgiris, statistics relating to the teak forests of Burma, a note on drought in the *sal* forests of the United Provinces, a preliminary note on the working of *Dendrocalamus strictus*, as the result of experiments carried out over a series of years, and various papers on other subjects. Statistics based on sample plot measurements have been regularly published since the completion of the first quinquennial remeasurements. When last on leave in 1913 Mr. Troup, who held the post of Sylviculturist from 1909 to 1914 and to whom much of our Sylvicultural progress in due, took the opportunity of visiting a number of continental forests with the object of studying the lastest developments in Sylvicultural systems. The results of this study were published in a very valuable note describing various continental systems of management and containing suggestions for improvements in forest management in India. Some of these suggestions have already been adopted in practice. It was at first the intention to produce monographs on the principal Indian trees somewhat on the lines of that on *Pinus longifolia*. This idea was afterwards

abandoned in favour of bringing out a complete work, in book form, dealing from a Sylvicultural point of view with all the principal trees of our Indian forests and with a number of species of secondary importance. This work, on which Mr. Troup has been engaged for some years, will be published shortly in England. It will embody the results of the Sylvicultural work of the Institute since the commencement and will certainly be of great value to all forest officers.

"It has now been recognized that future progress in Sylvicultural research must depend largely on the extent to which the work can be decentralized. But for the war, with the consequent suspension of recruitment for the Imperial Forest Service and the absence of so many officers on military duty, a good deal more would have been accomplished in this direction, as local Governments are alive to the importance of this branch of research. The ideal is for local Sylviculturists to work in different provinces, with the Forest Research Institute at Dehra Dun as a central agency for co-ordinating their work, recording results and distributing information.

"The first work undertaken in the Economic section was to co-ordinate and arrange all past records and information connected with forest utilization. These records, together with much valuable information collected from time to time by forest officers were further supplemented by the records dealing with forest products which were transferred to the Research Institute on the abolition of the office of the Reporter on Economic products. A further valuable contribution of wood and minor forest product collections was taken over from the Forest College; these were rearranged and classified during 1910-1911 and have since received many additions.

"The first enquiry of importance was in connection with the manufacture of matches in India. The direct result of this enquiry was the erection of a number of factories, from the working of which the many difficulties to be surmounted when carrying out such enquiries soon became apparent. The next question examined was the antiseptic treatment of timber, dealing with

the best methods of treatment and based on durability tests extending over many years. From the very nature of such an enquiry in India, where the treatment of timber is virtually unknown, definite results can only be obtained years after the initiation of the experiments. Still the work done resulted in the laying down by the United Provinces Government of an extensive plant for treating pine sleepers for the State Railways by the open tank process: this met with partial success, but had to be closed during the war, primarily for want of creosote. Since then the North-Western Railway have prepared a concrete scheme for the treatment of pine and fir sleepers in pressure cylinders and are now advertising for creosote.

"About the same time as the above, a complete scheme of enquiry was drawn up with the object of ascertaining the value of bamboos and grasses for the preparation of paper-pulp. An expert was appointed to carry out the chemicial side of the investigation, while the more likely areas were visited by the Forest Economist for the purpose of ascertaining data regarding the yield and the cost of extraction, and of selecting possible factory sites. Even, however, after the collection of what was considered to be conclusive proof that bamboos could be utilized commercially for paper-pulp, no firm took steps to start the industry, and it is only during the last 12 months that anything has been accomplished. There are now at least three companies, or syndicates, taking definite steps to erect plants, and though it is not permissible to state how far they have progressed with their arrangements, it may be assumed that bamboo-pulp will be on the market within the next 18 months to two years.

"Among the minor industries that of pencil-making was examined as early as 1909: but exhaustive experiments with a large number of timbers have shown that with the exception of Baluchistan Juniper, which is not available in commercial quantities, there is no first class pencil-making wood available in India, though several timbers have been found suitable for inferior grade pencils. The pencil-making industry, therefore, is at

present dependent on a Juniper timber from British East Africa for first grade pencils. In 1909 an enquiry was commenced to ascertain whether paving blocks could not be introduced into India: paving blocks were laid down experimentally in Rangoon, but the results were not altogether satisfactory. In 1915 a large number of blocks were supplied free to the Calcutta Corporation and the Bombay Municipality. The Calcutta experiments failed, though it is doubtful if this failure was due to the unsuitability of the blocks, for in Bombay the authorities were so well pleased with the results that they placed an order with the Forest Department for further consignments.

"Experiments were carried out in the laboratory and field to ascertain whether more up-to-date methods for distilling Rosha grass oil could not be introduced, and the results obtained were published. It is understood that a company has been granted a lease in the Central Provinces and is about to erect steam stills; this may lead to important results.

"A number of investigations have been in progress with the object of finding uses for Indian timbers at present not largely on the market, and discovering timbers suitable for special purposes. Thus as far back as 1913 *Anogeissus latifolia* was introduced in the East Indian Railway workshops at Jamalpur for shafts for welding hammers, and many timbers were tested for pencils, pen-holders and rulers, of which a few are at present in use. A bobbin factory, started in Calcutta, used Indian timbers only: these were found quite suitable, but the factory had to close down as no bobbin expert could be obtained in war time. Again three-ply woods were tested for a firm which has since erected an up-to-date three-ply factory. Another timber has recently been tested for rifle stocks which has passed all the workshop tests and is now being given a service trial. Then again, several Indian timbers have been tested for tent poles, boot-lasts, leather-cutting blocks, etc., etc., and some of them have proved to be eminently satisfactory. Many similar enquiries have been in progress; but the above instances are sufficient to show the lines along which work has been proceediug.

"Of recent years the three most important enquiries in progress have been in connection with :—

(*i*) The natural seasoning of timber, (*ii*) *Boswellia serrata* gum-oleo-resin and (*iii*) the possibility of preparing charcoal briquettes. Reports on the first two experiments have been issued and considerable attention is being paid to these subjects ; the third enquiry is still in progress. A variety of other experiments have been in hand, often instigated by enquirers, and a large number of mechanical tests have been carried out on timbers, both for constructional and special purposes.

"The results of the more important enquiries have been published. Forest Memoirs have been issued on *sal* timber, Indian woods and their uses and match-making : Forest Records on the antiseptic treatment of timber, the seasoning of timber, bamboos for paper-pulp, tea-box woods and *Boswellia serrata* gum-oleo-resin : Bulletins on a variety of subjects dealing with the mechanical properties of timber, and trade notes, published as Bulletins, on 18 of the more important species of Indian timbers. A Manual on Forest Utilization and a Commercial Guide have also been issued.

"Generally it may be claimed that the work of the Institute on the utilization side has stimulated an interest in Indian timbers and minor forest products, which is likely to have far-reaching effects, and has clearly demonstrated that, provided liberal funds are made available for plant and staff, the returns will be highly remunerative. In 1906 the Economic Branch was unknown. Now enquiries are received from all parts of the world and number over 3,000 a year. The start was made by Mr. Troup but Mr. Pearson has been in charge of the Branch since 1909, and the growth and influence exercised by the Branch are largely ascribable to the energy and ability with which he has carried on his duties.

"The staff of the Institute is partly occupied with educational work and the accommodation is limited. The necessity for extension has been recognized by the Government of India for some time past, and this matter was considered last July by a committee over which Sir Claude Hill presided. The scheme has not yet

received the final approval of the Government of India, as, among other things, certain questions regarding the plant required have not yet been decided, while the extent to which the educational side of the Institute may require expanding depends, as in case of the Rangers course, on the arrangements for the future training of Imperial Service recruits. Still I may say that if we get what the Committee decided to recommend, the Institute itself will be converted into a really fine building and the staff of Imperial research officers will consist of :—

(*i*) The Sylvicultural Branch with one Sylviculturist and two Assistant Sylviculturists.

(*ii*) The Botanical Branch with one Systematic Botanist, one Œcological Botanist, one Bacteriologist and one Mycologist.

(*iii*) The Entomological Branch with one Entomologist at head-quarters and four regional Entomologists.

(*iv*) The Chemical Branch with a Forest Chemist, a Soil Chemist and a distillation expert.

(*v*) The Economical Branch with one Forest Economist, one Assistant Forest Economist, one Wood Technologist, one Minor Forest Produce expert and experts in subjects, such as paper-pulp and tan stuffs and dyes, for such periods as may be required.

"Each Branch will have a number of subordinate assistants, while the Economic Branch will be equipped with plant sufficient for the production of commercial samples at the least. It is hoped, too, that the Heads of Branches will receive a moderate addition to the allowance now drawn by research officers and that the affairs of the Institute will be managed by a Council consisting of the President and the Heads of Branches. With this equipment, Gentlemen, and with the assistance of local research officers in provinces, we may, I think, be certain that the Forest Research Institute will be placed in a fair way to deal with the many scientific and commercial problems which await solution in connection with the proper development of the forests in the Indian Empire. I have only one other remark to make regarding

the Research Institute and that is that if it is to succeed we must have for the Branches staffed by forest officers, the best and most suitable men that can be found in the service, for unless the men here command the confidence of the Department generally, the Institute cannot fulfil its purpose. I trust that local Governments and their forest advisers realize and will remember this when the new posts are sanctioned and the time comes to select officers to fill them.

"Many things have happened, Gentlemen, in the last three years. As regards the sanctioned strength of the staff a moderate increase has to be recorded. On the 31st of March 1916 this was 235 Imperial Service and 233 Provincial Service officers. It is now 254 and 262 respectively, while the orders of the Secretary of State have not yet been received on one small scheme of reorganization providing for an increase of five Imperial and three Provincial officers in Bihar and Orissa, and two large schemes for Burma and Bombay are likely shortly to reach the Government of India.

The financial results of the Department have again improved considerably. For the year ending the 30th June 1915 the Revenue, Expenditure and Surplus for British India as a whole, including Burma, were Rs. 2,97,00,000, Rs. 1,82,00,000 and Rs. 1,15,00,000 while for the year ending the 30th June 1918 the corresponding figures were approximately Rs. 4,22,00,000, Rs. 2,12,00,000 and Rs. 2,10,00,000. The considerable increases in the price of timber and of forest produce of all kinds, due to war conditions, are responsible to some extent for this large increase in Revenue; but though perhaps we must expect some small set-back the figures quoted are eminently satisfactory as showing the increased volume of the business transactions of the Department. It is not possible to separate accurately the amount of the revenue and surplus derived from the reserved and protected forests from that coming from the unclassed forests. But I shall not, perhaps, be very far wrong if I allot four-fifths to the former class, including the forests in the Andamans, where there are no regular reserves at all. On this assumption the gross and net figures for the year 1917-18 amount to annual returns of 7·5 annas and 3·7 annas

per acre respectively for India as a whole including Burma. These figures may seem very small indeed in comparison with the returns derived from forests in Europe: but it must be remembered that vast areas of our forests in India and Burma are still unprovided with proper means of communications, that other very large areas are protection forests pure and simple, consisting of high mountain ranges, either above the limit of tree-growth or so situated that they are never likely to yield utilizable produce, that other very considerable areas are mainly grazing grounds stocked with tree growth of the poorest quality, that large quantities of produce valued at approximately 85 lakhs of rupees are either given free, or sold at privileged rates to right-holders and others, and, finally, that methods of concentrated working and the use of mechanical appliances for extraction are still in their infancy. If, however, the general average is low and shows the possibility of very great improvement there are instances in India of very fine returns indeed. Thus for the 6,500 acres of the Nilambur plantation working circle in the south Malabar forest division of the Madras Presidency, the figures in the year 1917-18 were Revenue Rs. 3,51,921, Expenditure Rs. 76,389 and Surplus Rs. 2,75,532, showing a net return of Rs. 42·4 per acre per annum. Again for the whole of the forests in the United Provinces, the net return per acre in the same year was 9·9 annas.

"Orders on the recommendations of the Public Services Commission as regards the Forest Department have not yet been issued. But a great deal of work in this connection has been done both by local Governments and by the Government of India, and it is, perhaps, permissible to say that when these questions are finally decided the officers of the Department generally may find their position as regards pay and pension considerably improved. Another result that is certain is that in future the Imperial branch of the service will contain a considerable and increasing proportion of Indian officers. Before the war very few Indian officers had entered the Imperial branch of the service. The reason for this state of affairs was, not that entry to the Imperial branch of the Forest Service was in any way more

difficult for Indians than to any other of the Indian services, but simply that the Indian gentlemen who went to England to complete their education had no use for the Forest Department and perferred services such as the Indian Civil Service, the Public Works Department and the Indian Medical Service. I think I may claim that the British officers of the service are prepared to welcome the entry of Indians of the right kind. But I think, also, that they are justified in doubting whether Indians of that kind are likely to come forward in sufficient numbers, at any rate at first: they know the present and prospective values of the vast Government estates committed to their charge; they know the necessity for the employment of really first class men if these estates are to be properly developed; and, judging by past history, they fear that the forest service is likely to obtain only the class of Indian recruit who is unable to find employment in the Imperial branches of other, and possibly more congenial services. We must trust the Secretary of State and the Government of India to see that we do not get men who are unsuited to the work. For the rest we must extend to the Indian recruits the same welcome that we have always given to the European, and we must endeavour by precept and example to instil into them the standards of keenness and efficiency which, I am thankful to say, have always characterized the members of our service.

"War conditions have prevented any rapid development of industries based on the utilization of forest produce. As mentioned previously, the manufacture of paper-pulp from bamboos has not yet been started, though various firms have entered into, or are likely shortly to conclude, agreements, with local Governments, and it seems certain that this important industry will soon be commenced in Burma and possibly in Bengal and on the West Coast of the Bombay Presidency. The manufacture of three-ply wood for tea-boxes and other purposes has been started as a going concern in Assam by Messrs Bird and Company, and you will see samples of this material, which seems to be of excellent quality, in the Economic Museum of the Institute. It appears that many of the so-called softwoods, which have hardly been utilized at all

up to the present, can be employed satisfactorily for this purpose, which promises, therefore, to be of great assistance in finding a use for timbers that have hitherto been regarded as more or less worthless. Another big project now rapidly approaching the starting point is that of Messrs. Davenport and Company at Rajabhatkhawa in Northern Bengal. This project is connected with the utilization of the outturn of all woods, other than *sal* from large Buxa reserved forest in the Buxa division of the Bengal Circle. It will embrace plant for the manufacture of three-ply wood, for destructive distillation, for the manufacture of charcoal briquettes and for the production of tannin extracts. Among smaller undertakings I may mention the modern plant installed at Ramnagar in the United Provinces for the extraction of Cutch, and a steam distillation plant for the extraction of Rosha oil, which is about to be erected in the Nimar district of the Central Provinces. Government, too, have not been idle in this matter of commercial forest development. The resin industry in the United Provinces and the Punjab has been steadily expanded and, though it has not yet reached anything approaching its full possibility, now yields a gross revenue of over 15 lakhs of rupees. In October last a special forest circle to deal with utilization was sanctioned in the United Provinces, while, in advance of the general reorganization of the staff in Burma, the Government of India have recently agreed to the creation of a similar circle in that province. Bengal, also, has instituted a utilization charge and other provinces will, it is hoped, not be long before they follow the lead thus given them. The plant now under erection by the United Provinces Government at Bareilly consists of a large and up-to-date resin distillery, on the lines of the French plant previouly installed by the Punjab Government at Jalloo which latter will, I understand, shortly be duplicated of a saw-mill to deal with miscellaneous timbers, of a bobbin plant, of kilns for seasoning timber, and of the previously existing wood-working institute, which it is intended to utilize as a centre for commercial research in timbers and for technical education. In the same province the extraction of Stockholm tar from stump wood of

pine fellings has been undertaken successfully, and this promises to develop into an important industry. In Bombay a metre-gauge forest railway some 20 miles in length has been built from the main Madras and Southern Mahratta Railway to Dandeli in the North Kanara division, and one new permanent saw-mill and three new portable saw-mills have been erected. Again a scheme has recently been sanctioned for the departmental development of forest work in the Andamans. This scheme will entail an expenditure of some 12 lakhs of rupees and will undoubtedly be remunerative.

"The most satisfactory development of recent years, and the one which, in my opinion, will exercise the greatest effect on the future of forest development in India, is in Sylviculture. I refer to the now general acceptance of concentrated methods of treatment in place of the so-called selection system. When this system was started very many years ago by the late Sir Dietrich Brandis it was the only treatment possible under the conditions then obtaining. But those conditions have changed greatly. The vast areas with which we have to deal, the want of communications, the sparseness of the forest population, the want of staff and the undeveloped state of the demand for many of our Indian timbers, will necessitate the maintenance of the selection system over very large areas for many years to come and will confine the introduction of more up-to-date methods of treatment to our most productive and most accessible forests. In special types of forest, such as the pure *Pinus longifolia* areas in Kumaon and Jaunsar, treatment on these lines has actually been in force for many years; but when, at the Burma Forest Conference in 1910, Mr. Troup advocated the more general application of the principle to natural mixed high forest, with special reference to the teak forests of Burma, the proposal met with a certain amount of opposition. Now, however, I am glad to say, that the majority of the officers in the service hold that it is not enough to be content with the removal of mature trees of a few of the most valuable species at long intervals, and with occasional intervening climber cuttings and more or less

perfunctory improvement fellings, in the interests of such regeneration as may be able to establish itself in the struggle for existence under natural conditions, which are often far from favourable to the very species we wish to reproduce. We hold, now, that it is our business to exercise more control over nature and to make every acre of such forests, as can be brought under the new methods, bear to its fullest capacity crops of the species which will yield the best results under the local conditions. Many difficulties, involving much patient research into local conditions and the characters and requirements of the various species, must be surmounted before we can attain this result. But it is only by first solving the many Sylvicultural problems involved, and then by applying the results to contracted systems of management, that we shall be able to get the full possibility out of our forests, to avail ourselves of American and Continental experience in the use of mechanical appliances for the extraction and transport of timber, and to place our less well-known timbers on the markets of the world in quantities that will ensure their finding purchasers at profitable rates. On the other hand, the adoption of concentrated methods of working will involve various obligations. In the first place, we must be prepared to put back into the forests a fair proportion of the revenue we derive from exploitation, and so secure the success of regeneration largely by artificial measures. In the second place, it will not be enough to place the timber on a line of rail, or on a seaport, in the form of logs and expect the public to buy it and turn it to use. I do not believe there is any reason why India should import timber for any purpose whatever. On the contrary, I hold that in the course of time India should be a very large exporter of timber of many kinds, instead of the best quality of teak, which, with small exceptions, forms practically all the timber that leaves India at present. But if this is to come about Government must be prepared to undertake pioneer work. Large saw-mills must be established and equipped with the most efficient and up-to-date drying kilns, so that timber is made available, seasoned and in the forms in which it can be utilized with the least subsequent trouble to the trade. Again with the saw-mills

must be associated plants for wood manufactures, such as veneers, ply-wood, matches, barrels, shingles, etc., etc. As Mr. Leete has pointed out in the report to which I have referred previously, the relations that exist between the development of lumbering and that of the industries which depend on it for their supplies of material, are intimate in Canada and the United States, for the one cannot develop without the other. This must hold good in India also, and if private initiative and capital are insufficient to deal with these matters, Government must either be prepared to take them up, at any rate until the suitability of the timbers for the various uses is proved sufficiently to induce private enterprise to step in, or be content to see the development of its forests postponed indefinitely.

"The position of the Forest Department in India is unique, for by far the greater part of the very extensive and really valuable forest tracts in the country are the property of Government, and so can be managed by the department in the best interests of the country. As I have shown above, the present return derived from the vast forest estate is a very small one; but if, on the one hand, the Government of India and the local Governments are prepared to provide the necessary staff, on terms which will attract men of the class required, and to sink the necessary capital in development; and if, on the other hand, the officers of the department go steadily ahead with concentrated work on the right lines, the future prospects will be very bright indeed. Few, if any, of us will be here to see it: but I think we may confidently look forward to the time when the Forest Department will be one of the greatest and most important services in India and when the revenue derived from the forest estates of Government will be many times greater than it is at present."

POSSIBILITIES OF A FIR AND SPRUCE LUMBER TRADE.

BY E. A. GRESWELL, I.F.S.

As Spruce and Fir have come to the fore under stimulus of the war demand, and working-plans of these forests are either being drawn up or are contemplated, it may not be out of place for the writer to put forward a few reflections based on the experience he gained while supervising the munitions timber supplies from the Punjab during 1917 and 1918.

Prior to the war the extensive tracts of Fir and Spruce forests in the Punjab and Kashmir had generally not been touched. Such logs and scantlings as reached the river depôts were the outturn of trees standing in Deodar and Kail forests; these were felled purely for sylvicultural reasons and the price obtained barely covered royalty and extraction charges.

Such was the position up to the end of 1916 when the war demand began. In the ensuing two years, approximately 80,000 tons of coniferous lumber were supplied from Punjab depôts to oversea bases and against various Indian indents, an amount in itself possibly less than the total extra tonnage absorbed by the Railways and Military Works Department for overseas and local consumption respectively.

Under this strain the available supplies of Deodar, Kail and Chir were rapidly exhausted and never adequately replaced, proving that the more extensive exploitation of these species is not yet possible. The deficiency, however, was fully made up by the ever-increasing supplies of Fir and Spruce especially from Kashmir. The overseas bases, chiefly Basra, received 20,000 tons of this timber, while the Military Works Department, which came late into the market, used it extensively on temporary barrack construction. The market price of the beam $14' \times 12'' \times 6''$ and over in length and section rose from a pre-war rate of Rs. 5 to Rs. 12 each, and of the log from annas four to Re. 1 per cubic foot.

It is, of course, too early to offer an opinion as to its durability in the works on which it has been used. Large quantities were

supplied as crating to Cawnpore factories, and now as tea chests to Calcutta; there is little doubt that for purposes of this nature it has no rival. As lumber for building works, however, local trade opinion has been in the past so antagonistic to its use that its suitability appears open to doubt. While its susceptibility to damp and, of course, white-ant attack is admitted, yet the absence of any proof as to its defects on other grounds justifies the assumption that trade opinion is unduly influenced by a prejudice probably based on its comparative value with that of the other more popular species or on the fact that the supply of these in the past sufficed to meet the local demand. Its known defects are insufficient to debar it completely from use under conditions favourable to durability.

Judging from the absence of complaints against this timber, when properly converted, the war bases have presumably found it satisfactory for building works. This is somewhat negative proof, yet it has been used so largely in Military Works barracks in the Punjab and at Quetta that ample data as to its suitability can, if necessary, be obtained. The most remarkable example of its use is in the new Grand Trunk Road bridge over the Haro, between Serai Kala and Campbellpur, in which the whole of the decking and part of the trestle-work is composed of Fir and Spruce supplied from Messrs. Spedding & Co.'s Saw-mills at Jhelum.

It is also interesting that three English saw-mill foremen who have visited these mills during the past year have expressed the opinion that there is no apparent difference between the Himalayan species and its European equivalent.

The suitability of Spruce for aeroplane construction was investigated by the aeroplane timber expert early in 1918, but his decision was unfavourable partly because of knots and partly because of short length. The only timber then available for inspection were some poor quality Kashmir Departmental logs and the ubiquitous beam from which nothing can be expected. There is little doubt, therefore, that the decision passed was premature. The Spruce logs which arrived subsequently from Messrs. Spedding & Co.'s forests in Kashmir were of magnificent quality and

undoubtedly up to specification; moreover, there is hope that some of the Kashmir forests at least can supply logs of the desired length even under the present methods of extraction.

The matter is worth further investigation more especially as the Himalayan Spruce is the longest fibred of all Spruces. At the same time the specification is so severe that the production of aeroplane Spruce alone is at present not a commercial possibility but can be worked only as an adjunct of an ordinary lumber business. The prospect of the infinitesimal yield of suitable timber obtainable militated largely during the demand against any further investigations into the possibilities of working standing Spruce. The extent of wastage can be gauged by the fact that in the earlier types of aeroplane the amount of finished Spruce timber was 20 cubic feet to produce which over 150 cubic feet of selected Sitka Spruce planking was required.

Unfortunately, the increased output of this timber has been devoted almost entirely to military consumption with the result that its possibilities have not been introduced to Indian markets outside the Punjab. Nevertheless samples sent to Calcutta in 1917 and 1918 drew an offer for long length slabs of over Rs. 3 per cubic foot f. o. r. Calcutta or, say, about Rs. 2-8 f. o. r. Punjab. This is, of course, an inflated rate but affords some proof that Fir and Spruce could, with freightage preference under normal conditions, compete successfully with imported Japanese Pine in the markets of Northern India.

It is a remarkable fact that a timber, so well known in the British lumber trade, is hardly recognized in India outside the Punjab. It is understood that in such adjacent territory as Sind and Baluchistan Fir can be substituted for Kail or Chir without comment. In the Karachi market all coniferous lumber was still quite lately known as Deodar and demanded a special rate apparently based on the rates of sea-imports. Again, Ordnance factories know only of Deodar and Chir, other coniferous species being covered by the vague term 'deal.'

It is clear from this that the Punjab trader has been in the past blind to the existence of other markets than the Punjab

bazaars, though a part of the blame is attributable to the petty quantities in which he deals, and to the high rates of railway freightage. It was not till a Bombay firm, early in 1917, had cornered the whole Deodar market, while another firm had, with considerable professional enterprise, passed off a large quantity of Fir sleepers as a suitable substitute for Sal that the local trader began to grasp the connection between his timber and the war. He has, moreover, little sense of combination or initiative and has therefore been an easy victim not only of his own failings, but also of the unsympathetic attitude of Government in meeting grievances which are often only too just.

For the promotion of trade Government activity is called for, and in this sphere the Kashmir Forest Department has already shown great enterprise. Being unable to find a sale for its Fir and Spruce a lease was issued to Messrs. Spedding & Co. at rates sufficiently low to cover the initial expenditure of erecting saw-mills at Jhelum and to compensate for possible failures in the pioneer work contemplated. These mills have now been working for two years and have been of incalculable assistance to munitions supply. They give a monthly output of 1,000 tons lumber, and are fitted with additional machinery for finishing and joinery work. This example is both instructive and refreshing, and judging from the excellent and previously unknown quality not only of the logs exploited but also of the outturn, it is safe to predict the complete success of the Kashmir policy.

As indicative of the future policy of Government, the writer may be forgiven for emphasizing his firm conviction based on two years' experience of the timber which reaches the river depôts and of the conversion of the same that it is only from long logs and large squares that satisfactory lumber of any description can be obtained. This applies to all Pine timbers but especially to the Fir and Spruce, which are the only species in which a surplus for export exists. If this is accepted, it is clear that greater attention must be paid to exploitation. At present logs, and these mostly in short lengths, are to be found only on the Jhelum and Indus rivers, while the vast majority of timber is brought

down in the form of more or less carelessly converted and often shattered scantlings of 10″ × 5″; 10″ × 6″ and 12″ × 6″ section in lengths from 9′ 6″ (Railway sleeper) to 16′. The production of timber in this form is inevitable under the present difficulties and methods of extraction, but if allowed to continue will retard the development of the Punjab lumber trade. Special stress is laid on this point because the true interests of the trade are apt to be clouded by the present and possible future high rates to be procured on the market and the danger that the Forest Department, owing to these rates, will either do nothing or will allow its attention to be diverted to interfering, under the semblance of pioneer work, in commercial activities which are not part of its true function and for which it is in no way fitted.

The greatest assistance which Government can now give in the development of the lumber trade lies in the improvement of all processes of conversion, extraction and grading up to delivery of the timber in the sale depôt. These improvements, at least on the Beas and the Sutlej rivers, are believed to involve severe engineering problems and heavy expenditure on permanent works, all of which are obviously beyond the capacity of the forest contractor. His existence is, in fact, a menace to trade development, and it will not be till the whole of his work has been taken over by Government with the honest intention of carrying out these improvements, not with the object of pocketing his profits, that progress will be made. The advantages derivable from the retention of such a monopoly by Government are too obvious to be enumerated.

In this connection the opinion of an officer for some time in the early part of the war responsible for Indian timber supplies to war bases is valuable as an independent summary of the situation:—

"If only India could supply more seasoned timber and timber in better lengths, the work would be much easier, but Government seems to have systematically starved the Forest Department so that there are no means of drawing out big logs and all the business seems to be in the hands of petty traders."

THE GROWTH OF SAL FROM BROADCAST SOWINGS.

BY G. M. COOPER, I.F.S.

In view of the, as a rule, very indefinite results obtained in attempts at artificially regenerating Sal either by planting or sowing the following results of the broadcast sowing of Sal should prove of interest.

In the hot weather of 1913, some ten acres of an old 'toila' (Chhana toila) in the Sulia Reserve of Nayagarh Feudatory State, Orissa, were sown up broadcast with Sal seed. The following table shows girth and height measurements of 50 average stems in this area taken on the 20th January 1919, *i.e.*, five years and eight months after the sowing:—

Serial No.	Girth in inches.	Height in ft. and inches.	Serial No.	Girth in inches.	Height in ft. and inches.
1	6·75	12 10″	26	4·50	13
2	6·62	14 9″	27	6·50	14
3	7·37	14	28	4·87	10 6″
4	6	12	29	4·25	10
5	4·25	11	30	5·75	14 5″
6	5·37	11 4″	31	4·87	11
7	5·12	12 3″	32	5·37	13 3″
8	4·37	9	33	7·12	15
9	6·12	12 8″	34	2·50	8
10	3·37	7 8″	35	4·75	14 6″
11	5	10 6″	36	6·37	13 4″
12	4·12	9 8″	37	6·12	12 4″
13	5·37	13 3″	38	5·62	12 8″
14	5·75	13	39	5·50	13
15	6·25	13 4″	40	5·62	13
16	4·62	11 2″	41	5·62	13 6″
17	3·12	10	42	4·50	13 6″
18	3·62	10	43	4	11 6″
19	3·75	11	44	6·62	12
20	5·37	13	45	5·75	12
21	5·37	14	46	5·87	15
22	3·62	10	47	4·50	12
23	5	12 6″	48	5·62	13
24	5·62	13 6″	49	3·75	10 6″
25	5·75	12	50	4·87	13 6″

This gives an average girth of 5′ 17″ and an average height of 12′ 2″ for the plot measured.

A brief history of this plantation is as follows :—

The area was an old 'toila' or 'jhum' very open and grassy but with a very scattered bush and small tree-growth of *Woodfordia floribunda*, *Zizyphus Jujuba*, *Cleistanthus collinus*, *Lagerstræmia parviflora*, *Terminalia tomentosa*, etc., but no Sal. Ten acres of this were thrice ploughed over in the hot weather of 1913 and sown up profusely with Sal seed broadcast. The existing open secondary growth was not cut back in any way but left to afford some shelter and protection. On examination after the rains of that year results appeared poor and the operation more or less a failure. The writer inspected it in the rains of 1916 and then found a profuse growth of young Sal up to 4′ in height. None of the plants appeared to be fully established or to have formed definite leading shoots, and were made up of two or more non-erect non-persistent shoots coming up in dense spear grass growth about 3′ high. No weeding or attention appeared necessary or desirable and the area was left entirely to itself except that it was, of course, carefully fire-protected. The writer again visited the place in November 1918 and found a fine crop of Sal saplings almost all fully established with characteristic 'carrotty' bark, healthy and vigorous. One particularly fine stem measured 12″ in girth and was by ocular estimate nearly 20′ high. The old open crop was now found in many cases to be interfering with the leading shoots of the Sal and to need careful cutting back. The factor of stocking might be put at least ·8 or rather nearly full, though it is at the present time difficult to say what a fully stocked crop of this age really is. Instructions were given for the formation of a sample plot here as an opportunity was offered of recording measurements from the seed upwards, and these measurements given in the table above show what Sal can do in less than six years from the actual seed.

On the strength of the results noted in 1916, a further ten acres of blank area in the Hathimunda Reserve of this State were similarly sown up in the hot weather of 1917. This area, when visited in November 1918, appeared at first sight to be covered with a dense growth of spear grass only, upwards of 4′ high

Closer inspection, however, showed a plentiful crop of young plants from 6″ — 2′ 6″ in height coming up in the grass, all seemingly healthy and strong. This grass growth was so rank that it was thought advisable to free out the actual tops of the young plants by merely pushing the grass aside or by slight cutting. On its present showing this area should give even better results than those recorded for Chhana toila. The cost per acre of the sowing and plouging worked out to less than Re. 1-8-0 in both cases. The soil might be classed as a sandy loam. Similarly sowings made elsewhere, though none of them so old as the Chhana toila, have almost all met with results except on the poorest soils and particularly lime rich soils. On a 'genguti' or 'ghooting' soil results are practically nil. This soil appears extremely unsuitable to Sal, and even when it is found growing on it it is very stunted and shows no height-growth.

This method appears to be an excellent and inexpensive means of introducing Sal in deserted village areas, old 'jhums' and podas' and blanks in a Sal crop where there is anything like a suitable soil and where climatic conditions are similar.

THE FOOD PLANTS OF INDIAN FOREST INSECTS.

BY C.F.C. BEESON, M.A., I.F.S., FOREST ZOOLOGIST.

PART III.

(*Continued from* Indian Forester, *pp.* 139—153.)

CHRYSOMELIDÆ.

Aspidomorpha sanctæcrucis, Fabr.

Defoliator.—Convulvulaceæ,[23] *Tectona grandis*.

Distribution.—[India; Burma.]

Blepharida hirsuta, Jacoby.

Defoliator.—*Boswellia serrata*.

Distribution.—Bombay.

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[23] Anon., 1915, J.B.N.H.S., XXII, No. 4, p. 767.

Calopepla leyana, Latr.

Defoliator.—*Gmelina arborea.*

Distribution.—[Bombay ; Assam ; Bengal ; U. P.].

Clitea picta, Baly.

Defoliator and shoot borer.—*Ægle Marmelos.*

Distribution.—[N. India.]

Colasposoma semicostatum, Jacoby.

Defoliator.—*Citrus Aurantium, Vitex Negundo.*

Distribution.—[Sikhim; Mungphu ; Cachar] ; Siwaliks, U. P.

Corynodes pyrophorus, Parry.

Defoliator.—*Cordia Myxa, Jasminum arborescens.*

Distribution.—[Himalayas ; Nepal ; Assam ; Burma ; China] ; Siwaliks, U. P.

Crioceris impressa, Fabr.

Defoliator.—*Ficus elastica, Holarrhena antidysenterica.*

Distribution.—[India ; Burma ; Ceylon ; Andamans ; Malaya ; etc.].

Criocerus quadri-pustulata, Fabr.

Defoliator.—*Terminalia tomentosa, Trewia nudiflora.*

Distribution.—[Tenasserim ; Siam ; Java] ; Siwaliks, U. P.

Cryptocephalus pusænsis, Jacoby.

Defoliator.—*Tamarix gallica.*

Distribution.—[Pusa.]

Diapromorpha turcica, Fab.

Defoliator.—*Acacia Catechu.*

Distribution.—[India ; Ceylon.]

Estigmena chinensis, Hope.

Defoliator and shoot borer.—*Dendrocalamus strictus, Cephalostachyum pergracile.*

Distribution.—[Bombay ; Madras ; Berar ; Burma.]

Eubrachis indica, Baly.

Defoliator —*Æsculus indica.*

Distribution.—[Kashmir ; Himalayas ; Mussoorie ; N. India] ; Bashahr, Punjab.

Melasoma populi, Linn.

Defoliator.—*Salix elegans, Salix babylonica, Populus ciliata.*

Distribution.—[Europe, Asia] ; N.-W. Himalayas.

Mimastra cyanea, Hope.

Defoliator.—*Grewia asiatica, Pyrus communis, Pyrus Pashia.*

Distribution.—W. Almora, Naini Tal, Siwaliks, U. P.

Platypria andrewesi, Weise.

Defoliator.—*Zizyphus Jujuba.*

Distribution.—[India.]

Platypria hystrix, Jacoby.

Defoliator .—*Erythrina indica,*[24] *Sesbahia grandiflora.*

Distribution.—[Ceylon ; S. India] ; W. Almora, U. P.

Podontia quatuordecim-punctata, L.

Defoliator.—*Spondias mangifera, Ficus elastica.*

Distribution.—[India ; Andamans] ; N. Toungoo, Burma.

Sagra femorata, Drury.

Stem borer.—*Mucuna atropurpurea.*

Distribution.—[India ; China ; Borneo ; Java.]

Sagra longicollis, Lacord.

Wood borer.—*Tectona grandis.*

Distribution.—[Assam] ; Katha, Burma.

Sagra jansoni, Baly.

Wood borer.—*Tectona grandis.*

Distribution.—[Madras] ; Tharrawady, Burma.

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[24] Fletcher, 1917, B. pp. 74—77.

CISTELIDÆ.

Cistelomorpha andrewesi, Fairm.

Defoliator.—*Pinus excelsa.*
Distribution.—Chakrata ; Siwaliks, U. P. ; Simla, Punjáb.

Cistelomorpha annuligera, Fairm.

Defoliator.—*Cedrus Deodara, Pinus excelsa.*
Distribution.—Chakrata, U. P.

CURCULIONIDÆ.

[Distribution according to Marshall, G. K. (1916), Fauna of British India, Curculionidæ, Part I.]

Alcides affaber, Fst.

Shoot girdler.—*Ficus bengalensis.*
Distribution.—Bengal.

Alcides frenatus, Fst.

Shoot borer.—*Mangifera indica.*
Distribution.—[Bhamo, Burma] ; Bengal.

Alcides ludificator, Fst.

Sapling borer.—*Tectona grandis.*
Distribution.—Katha, Pyinmana, Toungoo, Ruby Mines, Burma.

Alcides porrectirostris, Mshl.

Seed borer.—*Juglans regia.*
Distribution.—Bashahar, Punjab.

Alcides westermanni, Boh.

Shoot girdler.—*Ficus religiosa.*
Distribution.—Chakrata, Mussoorie, Naini Tal, Siwaliks U. P. ; Lebong.

Apoderus bistriolatus, Fst. [25]

Leaf roller.—*Prunus Padus*, *Quercus dilatata*, *Quercus incana*.
Distribution.—N.-W. Himalayas ; Kangra, Punjab.

Apoderus blandus, Fst.

Leaf roller.—*Dalbergia Sissoo*.
Distribution.—[Burma] ; Pusa ; Siwaliks, U. P.

Apoderus dentipes, Fst.

Leaf roller.—*Desmodium* sp., *Quercus dilatata*.
Distribution.—[India ; Burma] ; Chakrata, U. P.

Apoderus sissoo, Mshl.

Leaf roller.—*Dalbergia Sissoo*.
Distribution.—Kangra, Kulu, Bashahar, Lahore, Punjab ; Kumaun, Garhwal, Siwaliks, U. P.

Apoderus tranquebaricus, Fabr.

Leaf roller.—*Terminalia Catappa*.
Distribution.—[S. India] ; Kanara, Bombay.

Astycus aurovittatus, Hell.

Defoliator.—*Tectona grandis*.
Distribution.—[Madras ; Mysore ; Coorg.]

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[25] This species is referred to in "Indian Forest Insects," pp. 416—418, as *Apoderus incana*, Stebbing. In a letter, dated 9th November 1915, Dr. G. K. Marshall informs me that he considers *incana*, Steb., to be a synonym of *bistriolatus*, Fst. The synonomy of the species (in departmental literature) is as follows :—

Apoderus sp , Stebbing, Ind. For., XXIX. p 104.

Apoderus incana, Ms. Stebbing, Deptl. Notes, 1903, pp. 189—192. Plate VIII, Figs 7 *a—c*.

„ Stebbing, Man. For. Zool., 1908, p. 103, Plate. XLI, Fig. 206.

„ Stebbing, Ind. For. Ins. Col., 1914, pp. 416—418, Fig. 281.

Astycus chrysochlorus, Wied.

Defoliator.—*Hevea braziliensis*, [26] *Pithecolobium Saman*. [27]

Distribution.—[Madras; Bengal; Assam; Sikkim; Burma]; Malaya.

Astycus lateralis, F.

Defoliator.—*Camellia Thea*,[28] *Tectona grandis*.

Distribution.—[India; Burma; Siam; Malaya.]

Atmetonychus peregrinus, Olive.

Defoliator.—*Prunus communis*, *Prunus persica*, *Mangifera indica*, *Zizyphus Jujuba*.

Distribution.—[Punjab; U. P.; Bihar; Bengal]; Katha, Burma; Seoni, C. P.

Attelabus discolor, Fabr.

Leaf roller.—*Anogeissus latifolia*.

Distribution.—Bombay; South Coimbatore, Madras.

Attelabus octomaculata, Jekel.

Leaf roller.—*Grewia tiliæfolia*.

Distribution.—South Coimbatore, Madras.

Brachyxystus subsignatus, Fst.

Defoliator.—*Abies Webbiana*, *Cedrus Deodara*, *Picea Morinda*.

Distribution.—N.-W. Himalayas of Punjab and U. P.

Cercidocerus bimaculatus, Boh.

Defoliator.—*Dalbergia latifolia*.

Distribution.—Coimbatiore, Madras; Siwaliks, U. P.

Conarthrus jansoni, Woll.

Shothole borer.—*Shorea robusta*.

Distribution.—[Assam.]

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[26] Green, 1916, p. 628. [27] Fletcher, 1917, p. 38. [28] Barlow, 1899, p. 184.

Conarthrus vicinus, Woll.[29]

Shothole borer.—*Dendrocalamus strictus.*

Distribution.—[India ; Burma ; Cochin China.]

Cryptorrhynchus raja, Steb.

Wood borer.—*Pinus excelsa.*

Distribution.—Chamba, Tehri Garhwal.

Cryptorrhynchus brandisi, Steb.

Wood borer.—*Pinus Khasya, Pinus longifolia, Tectona grandis.*

Distribution.—Himalayas, U.P. and Punjab ; Chamba, Garhwal ; Shillong, Assam ; Tharrawaddy, Burma.

Cyrtepistomus pannosus, Mshl.

Defoliator.—*Tectona grandis.*

Distribution.—Berar, Jubbulpore, C. P.

Cyrtotrachelus dux, Boh.

Wood borer.—*Dendrocalamus Hamiltonii.*

Distribution.—[India ; Burma.]

Cyrtotrachelus longipes, Fabr.

Wood borer.—*Dendrocalamus strictus, Melocanna bambusoides.*

Distribution.—[India ; Burma.]

Dereodus mastos, Hbst.

Defoliator.—*Acacia arabica.*

Distribution.—[Madras ; Ceylon.]

Dereodus pollinosus, Redt.

Defoliator.—*Pyrus Malus, Shorea robusta, Zizyphus Jujuba.*

Distribution.—[Baluchistan ; Punjab ; Kashmir ; Almora, Kumaon, Jaunsar, U. P. ; Nepal].

Emperorrhinus defoliator, Mshl.

Defoliator.—*Alnus nitida, Prunus armeniaca, Pyrus communis, Pyrus Malus.*

Distribution.—[Punjab ; Sikkim ; Assam.]

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[29] *Conarthrus affinis,* Woll. of Stebbing, 1914, p. 454.

Episomus lacerta, F.

Defoliator.—*Dalbergia paniculata, Erythrina indica, Tectona grandis.*

Distribution.—[Bengal ; Bombay ; Coorg ; Madras.]

Eugnamptus marginellus, Fst., Var. **semirufus,** Fst.

Defoliator.—*Mangifera indica.*

Distribution.—C. P.

Eugnathus curvus, Fst.

Defoliator.—*Butea frondosa.*

Distribution.—Siwaliks, U. P. ; Assam.

Himatium asperum, Marshall.

Shothole borer.—*Shorea robusta.*

Distribution.—Goalpara, Assam.

Hylobius angustus, Fst.

Shoot girdler.—*Pinus excelsa.*

Distribution.—Chakrata, U. P.

Hypomeces squamosus, F.

Defoliator.—*Bombax malabaricum, Hevea braziliensis,*[30] *Hibiscus rosa-sinensis.*

Distribution.—[Burma ; Siam ; Cambodia ; Malaysia ; China.]

Leptomias bipustulatus, Fst.

Shoot girdler.—*Gardenia turgida.*

Distribution.—[Chamba, Dalhousie, Punjab ; Almora, Kumaon, Siwaliks, U. P.]

Myllocerus catechu, Mshl.

Defoliator.—*Acacia Catechu.*

Distribution.—[Poona, Bombay.]

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[30] Green, 1916, p. 628.

Myllocerus discolor, Boh.

Defoliator.—*Ficus Maruoides*,[81] *Erythrina suberosa*,[82] *Mangifera indica*,[83] *Psidium Guava*,[84] *Zizyphus Jujuba*.[85]
Distribution.—[Punjab ; U. P. ; Bengal ; Madras.]

Myllocerus discolor, Var. uniformis, Mshl.

Defoliator.—*Dalbergia Sissoo*.
Distribution.—[Jaunsar, U. P.]

Myllocerus discolor, Var. variegatus, Boh.

Defoliator.—*Acacia Intsia*, *Dalbergia paniculata*, *Tectona grandis*.
Distribution.—[Bombay ; Madras ; Ceylon; Burma.]

Myllocerus fabricii, Guer.

Defoliator.—*Acacia* sp., *Casuarina equisetifolia*.
Distribution.—[Madras ; Bengal.]

Myllocerus lefroyi, Mshl.

Defoliator.—*Butea frondosa*, *Prunus Cerasus*.
Distribution.—[Siwaliks, U. P. ; Bengal.]

Myllocerus lineaticollis, Boh.

Defoliator.—*Bombax malabaricum*.
Distribution.—[Bombay ; Madras ; Assam.]

Myllocerus pustulatus Var. maculosus, Desbr.

Defoliator.—*Dalbergia Sissoo*, *Mangifera indica*[83], *Psidium guava*,[84] *Pyrus Malus*, *Zizypus Jujuba*.[85]
Distribution.—[Punjab ; U. P. ; Bengal ; Madras.]

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[81] Fletcher, 1917, p. 216.
[82] ,, ,, p. 250.
[83] Fletcher, 1917 p. 219.
[84] ,, ,, p. 231.
[85] Fletcher, 1917. p 235

Myllocerus sabulosus, Mshl.

Defoliator.—*Casuarina equisetifolia, Mangifera indica, Psidium Guava, Zizyphus Jujuba.*

Distribution.—[Siwaliks, U. P.; Bengal ; Madras.]

Myllocerus setulifer, Desbr.

Defoliator.—*Dalbergia Sissoo, Rosa* spp.

Distribution.—[Siwaliks, U. P.]

Myllocerus transmarinus, Hbst.

Defoliator.—*Dalbergia Sissoo ; Zizyphus Jujuba.*

Distribution.—[Punjab ; U. P. ; Bengal, C. P ; Bombay ; Madras.]

Myllocerus viridanus, F.

Defoliator.—*Psidium Guava, Tectona grandis.*

Distribution.—[Madras ; Cochin ; Mysore ; Ceylon.]

Pachyonyx quadridens, Chevr.[36]

Gall former.—*Butea frondosa.*

Distribution.—Khandesh, Bombay ; Jubbulpore, C. P.

Peltotrachelus [Platytrachelus] juvencus, Fst.

Defoliator.—*Acacia Catechu.*

Distribution.—Bombay ; Siwaliks, Kheri, U. P.

Phæomerus angulicollis, Mshl.

Shothole borer.—*Heritiera Fomes.*

Distribution.—Sunderbans, Bengal.

Phæomerus brevirostris, Mshl.[37]

Shothole borer.—*Shorea robusta.*

Distribution.—Jalpaiguri, Buxa, Bengal.

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[36] This species is probably identical with that referred under the name of *Larinus ?* sp. (The Calas-tree gall weevil, on pp. 410—412 of Indian Forest Insects.—C.F.C.B.

[37] Marshall (1917), Ann. Mag. N. H., Vol. 19, Ser. VIII, No. 110, p. 198, gives the locality of the type specimens as United Provinces, Khairabanda, Khash Forest, 29, XI. 1913 *(C. F. C. Beeson).* Khairabanda forest is in Jalpaiguri Division, Bengal, not U. P.—C. F. C. B.

Phæomerus sundewalli, Boh.

Shothole borer.—*Butea frondosa, Dalbergia Sissoo, Heritiera Fomes, Shorea robusta.*

Distribution.—Siwaliks, U. P.; Jalpaiguri, Buxa, Sunderbans, Bengal; Tista, Goalpara, Assam; Kanara, Khandesh, Bombay; Karen Hills, Bhamo, Burma.

Protocerius grandis, Guer.

Stem borer.—*Phœnix paludosa.*

Distribution.—Pegu, Burma.

Rhyncholus himalayensis, Steb.

Shothole borer.—*Cedrus Deodara, Picea Morinda, Pinus excelsa.*

Distribution.—[Punjab and U. P. Himalayas.]

Rhynchophorus ferrugineus, Oliv.

Wood borer.—*Cocos nucifera, Phœnix dactylifera, Phœnix sylvestris.*

Distribution.—[India; Burma; Ceylon.]

Sipalus hypocrita, Boh.

Wood borer.—*Æsculus punduana, Bombax malabaricum, Dalbergia cultrata, Pinus Khasya, Pterocarpus dalbergioides.*

Distribution.—[India; Burma.]

Sympiezomias cretaceus, Fst.

Defoliator.—*Coffea arabica, Morus* sp.

Distribution.—[Madras.]

Stelorrhinus carinirostris, Mshl.

Defoliator.—*Tectona grandis.*

Distribution.—[Assam; Tharrawaddy, Burma.]

Trigonocolus brachmanæ, Fst.[38]

Shoot borer and girdler.—*Butea frondosa*, *Ougeinia dalbergioides*, *Pterocarpus dalbergioides*.

Distribution.—Andamans ; Bhamo, Toungoo, Thagata, Palon, Karen Hills, Burma ; Siwaliks, U. P.

Xylinophorus pencillatus, Mshl.

Leaf roller.—*Desmodium* sp.

Shoot girdler.—*Gardenia turgida*.

Distribution.—[Simla, Punjab ; Jaunsar, Garhwal, Kumaon, U. P.]

References to Literature.

Anonymous, 1915, Jour, B. N. H. S., XXII, No. 4, p. 767.

Barlow, E., 1899, Ind. Mus. Notes, IV.—*Notes on Pests from the Entomological Section*, p. 184.

Fletcher, T. B., 1917. B.—*Report of the Proceedings of the 2nd Entomological Meetings*, February 1917.

Green, E. E., 1916, *On some Animal Pests of the Hevea Rubber Tree*. Trans. 3rd Int. Congr. Trop. Agric., pp. 608—636.

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[38] This insect is referred to by Stebbing, 1914, p. 425 et seq. as *Trigonocolus subfasciatus*, Fst., "the Andamans Padauk weevil." As the specimens in the Research Institute collected by Mr. B. B. Osmaston in the Andamans were evidently not *bifasciatus*, I sent them to Dr. G. K. Marshall for opinion. He informs me (27th January 1916) that the specimens are all of one species, namely, *T. brachmanæ*, Fst. The food plants and distribution of the insect appear to be extensive and I propose to drop the name "Andaman's Padauk weevil" as unsuitable. The following references in Indian Forest Insects must be included in the synonomy of *brachmanæ*, Fst.

Trigonocolus subfasciatus, Stebbing (nec Faust), 1914, Ind. For. Ins., pp. 425—427, fig. 287, pl. XXX—XXXV.—C. F. C. B.

PRIZE-DAY AT THE FOREST RESEARCH INSTITUTE AND COLLEGE, DEHRA DUN.

The annual prize distribution of both the Provincial and Ranger Classes was held on the premises of the Forest Research Institute on the 26th March 1919, in the presence of Mr. G. S. Hart, C.I.E., the Inspector-General of Forests.

Mr. Perrée, the President of the Forest Research Institute and College, opened the proceedings by reading the following report :—

MR. HART, GENTLEMEN.

"I beg to present the following report on the Provincial and Ranger classes who have now concluded their period of training.

Dealing first with the Provincial Service class.

This is the first occasion on which the class has completed the full period of twenty-four months' training under the present system, as the classes of the past two years, having joined in July, were unable to undergo more than 21 months' training. The present outgoing students have, therefore, had the full advantage of the complete course. The class opened with 15 students. One resigned, so only 14 completed the course.

In addition to the usual tours in Jaunsar and the Dun, two most instructive tours were undertaken. The first, in the Kulu and Kangra forests of the Punjab at the commencement of the second year, and the second, in the forests of Southern India, at the end of the course. The results of the oral examinations on the main points of the Kulu tour indicate, however, that the students, as a whole, did not profit to the fullest extent possible and it would appear that this tour, if repeated, should, in future, be taken in a more leisurely manner so that the students could themselves perform and master thoroughly all the works which together form the feature of the management of these forests. The South India tour, conducted by Mr. Bourne, who has intimate knowledge of the forests, proved most instructive and beneficial.

The class, as a whole, is of only average attainments and below last year's standard. The student who heads the list and has secured Honours has done so by the narrowest margin. He

is run close by the next few men who unfortunately failed to secure Honours' marks. I regret to have to record the failure of one student to obtain the pass certificate. This student failed in Forestry, although he obtained Honours' marks in the remaining major subjects. This latter fact would appear to indicate that the student could have done better in Forestry and as the rules preclude condoning of failure in this, the principal subject, no other course remained than an entry of his failure. His Government is being informed of these facts.

Referring to the Rangers.

This class originally consisted of 36 students, one left the College, a second was removed for ill-health and incapacity so that only 34 completed the course. Unfortunately, one student was unable to attend any of the final examinations owing to serious illness, and it is proposed to allow him again to undergo the second year's course if his Local Government desires that he should do so.

Of the 33 who finally competed four have obtained Honours, 25 have Higher Standard certificates and four have Lower Standard certificates.

Although the general level of the class is good, it does not come up to the standard of the last two years and is lacking in men of outstanding merit. Shortness of staff and illness among instructors have somewhat handicapped the training, as it is obviously difficult for a single instructor efficiently to deal with the large number composing this class.

The practical work was carried out in the forests of Tehri-Garhwal, Jaunsar and Dehra Dun, ending with an instructive tour in the Ramnagar Division of the United Provinces in which the system of conversion from the selection to the uniform method was seen.

The discipline of the class was good and their work in the field has been characterized by cheerfulness and a laudable degree of keenness.

The health of the students has, with the exception of a bad epidemic of influenza in July, been good, both among Provincial

and Ranger students. Unfortunately two of the junior rangers succumbed to influenza, but it is perhaps worthy of mention, as an indication of the beneficial effects of a forest training, that while 90 per cent. of the junior students, with only three months of their forest life to their credit, fell victims within four days of the first outbreak, their senior mess-mates, sharing their quarters and class rooms, had only 33 per cent of their numbers effected. During the second and more severe epidmic in October, the classes were in camp and no cases occurred.

There has been a tendency among certain Ranger students to report themselves sick for some slight ailment with the evident intention of thereby gaining a holiday. As physical fitness is an important qualification for a forest life, students should not forget that this practice is carefully noted in order to help in the allotment of marks for general fitness and conduct.

A couple of years ago, the system of appointing student monitors for the classes was introduced and has proved a success. Those monitors who prove themselves worthy of the responsibility and trust reposed in them are having their certificates endorsed with appreciatory remarks to the above effect.

In the important matter of games, which are shared by the Provincial and Ranger classes, there has been a considerable improvement although there is still room for further improvement. The Association Football team was a good one and in playing various battalions of the garrison had few points scored against it. There was unfortunately a weakness in attack, but the Inter-platoon Cup of the Mussoorie Indian Defence Force was nevertheless won by a team composed of members of the College team. In Cricket, the team was one of the strongest we have had for some years and would have been even better had the captaincy been in more capable hands. The Hockey was, on the whole, good. The sports were unfortunately marred by a violent hail-storm which ruined the timings and precludes comparison with the results of previous years. The Championship cup was won by Jagan Nath Datt, while the Inspector-General of Forests' Cup for the best athlete has been awarded to Mohammed Amin.

In conclusion, I must express my thanks to the members of the staff of the Research Institute and College for the loyal assistance rendered at all times, and especially in the conduct of the final examinations which this year have proved particularly arduous owing to the absence of officers through illness. To local Forest Officers special acknowledgment is due for hearty co-operation in making the tours a success. The Superintendent of the Trigonometrical Survey again, at considerable inconvenience, lent an officer to conduct the final survey examination and we thank him for invariably helping in this manner.

To the late President I must specially express my gratitude for the time and trouble taken by him in posting me up in College matters and for his valuable notes, with the help of which I have been able to prepare the foregoing report.

I regret that my short experience of the educational work at this institution has precluded my making it more interesting."

The certificates were then distributed by the President, and the prizes by the Inspector-General of Forests.

PROVINCIAL SERVICE CLASS.

Order of Merit.	HONOURS CERTIFICATE.
1.	D. Narasimhamoorty Rao (Mysore).
	PASS CERTIFICATES.
2.	C. M. Kushalappa (Madras).
3.	Sarbeswar Sarma (Assam).
4.	Narendra Nath Das (Assam).
5.	Jagan Nath Dutt (Bombay).
6.	C. J. Van Haefton (Madras).
7.	N. Venkatarama Iyar (Mysore).
8.	Maung Hman (Burma).
9.	F. George Caldecourt (Burma).
10.	Madan Mohan Singh (United Provinces).
11.	Syed Zenul-Ibad Rizvi (United Provinces).
12.	Kay Kyaung Sein (Burma).
13.	Ganga Prasad Mehrotra (Kashmir).
	FAILED.
14.	Vaman Rao Gangakhedkar (Hyderabad).

MEDALS AND OTHER PRIZES.

Gold Medal for highest marks with Honours Certificate.	D. Narasimhamoorty Rao.
Silver Medal for best student in Forestry ...	C. M. Kushalappa.
Do. do. in Botany ...	Sarbeswar Sarma.
Do. do. in Surveying ...	D. Narasimhamoorty Rao.
Do. do. in Engineering ...	Do. do.
The Hon'ble Members' Prize for the most promising student.	C. M. Kushalappa.
Hill Memorial Prize for the best student in Sylviculture.	Do. do.
The "Indian Forester" Prize for the best student who has got no other prize.	Narendra Nath Das.

RANGERS CLASS.

HONOURS CERTIFICATES.

Order of Merit.	
1.	Durga Das Jat Chopra (U. P.).
2.	Indra Jit Sharma (C. P.).
3.	Francis Xavier Miranda (Bombay).
4.	Krishna Govind Rahalkar (C. P.).

HIGHER STANDARD CERTIFICATES.

5.	Tej Bhan Bhatia (Kashmir).
6.	Mohammed Amin (Punjab)
7.	Ganesh Pershad Bajpai (C. P.).
8.	Benoy Krishna Chatterji (Assam).
9.	Ram Loke (Punjab).
10.	Bhimbahadur Pradhan (Sikkim).
11.	Parmal Singh (Gwalior).
12.	Ram Ratan (Patiala).
13.	Joachim Vincent Rego (Bombay).
14.	Swarup Singh Malik (Kashmir).
15.	Bhagwan Das Kausakia (C. P.).
16.	N. Krishna Limaye (Bombay).
17.	V. Ramrao Dhareshwar (Bombay).
18.	Gopal Dutt Pant (U. P.).
19.	D. Ramchandra Sathaye (Bombay).
20.	Vishnu Gajanan Narurkar (Bombay).
21.	Jai Narayan Shukla (Indore).
22.	Rashik Lal Khasgiwala (Partabgarh).
23.	Mohammed Wahajuddin (U. P.).
24.	Babu Ram (U. P.).
25.	Vidya Sagar Sharma (Mailog).
26	Bijai Singh Rawat (U. P.).
27	Deputylal Kishorilal Sharma (Bombay).
28.	Lakshmi Narayan Nigam (Bhopal).
29.	Murli Dhar Juyal (U. P.).

LOWER STANDARD CERTIFICATES.

30.	Gilbert Lobo (Bombay).
31	Balwantrao Naranji Desai (Bombay).
32.	Jaffar Husain (Bihar and Orissa).
33.	Piyare Lal Jain (Jubbal).

MEDALS AND OTHER PRIZES.

Gold Medal for Honours Certificate. ...	Durga Das Jat Chopra (U. P.).
Silver Medal to the best student in Forestry.	Do. do.
Do. do. in Botany.	Benoy Krishna Chatterji (Assam).
Do. do. in Engineering.	Indra Jit Sharma (C. P.).
McDonnel Memorial Medal (Best all-round student from Punjab and Kashmir).	Tej Bhan Bhatia (Kashmir).
Fernandez Memorial Gold Medal (Best in Utilization).	Francis Xavier Miranda (Bombay).
William Prothero Thomas Memorial Prize (Best Practical Forester).	Durga Das Jat Chopra (U. P.)
"Indian Forester" prize (Best student who has got no other prize).	Mohammed Amin (Punjab).
Inspector-General of Forests' cup for the best athlete.	Do do.

In conclusion, the Inspector-General of Forests addressed the students as follows :—

OUTGOING STUDENTS OF THE PROVINCIAL SERVICE AND RANGER CLASSES,

"Though neither class contains as brilliant men as those who headed the lists last year, Mr. Perrée's report on your work and conduct is satisfactory generally, and I am satisfied that the standard you have reached is a fairly good one, if not quite up to that of some of the past years. You leave Dehra Dun now with your careers ahead of you and with excellent prospects. In nearly every province in India the pay of the Rangers now rises to Rs. 200 per mensem, while the Government of India have recently decided to place no limit to the recruitment of the Provincial Service from the Ranger staff, but to leave the proportion of the vacancies to be filled by such promotion to the discretion of local Governments.

Again the Reforms Scheme will almost certainly result in reserving some proportion of the vacancies in the Imperial branch of the service for recruitment by selection from the Provincial Service. It is possible, therefore, that in the years to come some of you will be in positions of great responsibility, carrying

considerably higher salaries than you had any hope of obtaining when you commenced your training. I want to try and impress on you that the chance of your reaching these positions depends entirely on your own efforts. Promotion from the Ranger staff to the Provincial Service, and from the latter to the Imperial branch, will not go by seniority, but by selection and your selection for any of the higher appointments open to you will depend far more on your proving your worth by the work you do in the forest charges of your provinces than on the position you now hold in your class lists.

Owing to the great war and the number of forest officers who have joined the military forces of the Empire, the teaching staff has been below strength for some time past, with the result that although your Instructors have loyally endeavoured to fill the gap, your course has not perhaps been quite as good as was intended. It was impossible to prevent this as men to fill the vacant posts were not available. Still what you learn here is only a small fraction of what you have to learn if you are to become really proficient forest officers.

The necessity for the curtailment of expenditure due to the war has prevented the scheme for the decentralization of the Rangers' training being brought into force. But the students now joining the College from the Central Provinces, Bihar and Orissa, and the Central India States are the last that are likely to come to Dehra Dun from these localities, for it has been arranged that with effect from next year students from these places shall be trained at the Madras Forest College at Coimbatore. This will enable the Dehra Dun College to meet the urgent requirements of the other provinces to a greater extent than has been possible in recent years.

I congratulate the gold medallists, the other ranger students who have obtained honours, and the prize winners generally. Since the Provincial Service course was established, this is, I believe, the first time a ranger student has won the Inspector-General of Forests' cup for the best all-round athlete. I am very sorry that the cup has not arrived in time for me to present it to-day, but

I hope to give it to the winner, Mohammed Amin, to-morrow, and I am glad to see that he comes from my own province, the Punjab. I am sure you all regret that Mr. Osmaston has relinquished the post of President, Forest Research Institute and College, to take up another appointment; but Mr. Perrée, his successor, is an officer of wide experience who will, I know, not only carry on the good work of his predecessors, but will not be content until he has succeeded in raising the previous high standard of the work done both in the Research Institute and the College."

STOCK-MAPPING FROM THE AIR.

BY J. N. OLIPHANT, I. F.S.

The commercial development of the Forest Department is most seriously retarded by the lack of proper stock maps of forest containing species of timber hitherto little exploited; many of these species are of considerable potential value. Manufacturers often enquire in what quantity the timber of a particular species, which they have found useful on an experimental scale, can be regularly supplied, and we are unprovided with even the roughest data on which to reply. Obviously, it is up to the Department to carry out a detailed survey of its resources in the least possible time. With existing methods of stock-mapping the time occupied would be unconscionable, but it would seem that the work could be accomplished comparatively rapidly by aerial photography. I think it would be found possible by the use of suitable colour-filters and colour-sensitive plates, and by taking photographs at different seasons of the year, to differentiate many species by their foliage. Having located the species with reference to topographical features, the collection by a ground survey of data not obtainable from the aerial photographs should be fairly simple and expeditious.

The Home military authorities should be able immediately to place experts in aerial photography, and apparatus, at the disposal of the Department if the wheels were set in motion promptly. This is perhaps too much to hope for in India, but if the present opportunity is let slide the development of an aerial survey branch is

likely to be slow. That the method suggested is bound to be adopted in the process of time I personally do not doubt; at all events, no one can now dismiss the idea as fantastic as might have been done a few years ago.

The Department has lost immense opportunities during the war of developing the use of hitherto valueless timbers, simply and solely owing to inadequate provision for survey of its resources and for preparation of working-plans; and even now the need for such provision as an essential preliminary to commercial expansion seems to be inadequately realized. To make up for lost ground short cuts are needed, and the short cut above suggested should at least be made the subject of experiment as soon as practicable.

[The use of aeroplanes for observation work, chiefly in regard to fire-protection, appears to have been initiated in Cadada. The idea above outlined has obvious possibilities and military aeroplanes and observation balloons could usefully be employed in peace time for work of this nature.—HON. ED.]

KING-EMPEROR'S BIRTHDAY HONOURS' LIST, 1919.

We are glad to see that the following members of the Forest Department figure in the recent Honours' List:—

COMPANION OF THE INDIAN EMPIRE.

Henry Haselfoot Haines, Esq., Conservator of Forests, Bihar and Orissa.

Robert Selby Hole, Esq., Imperial Forest Botanist, Dehra Dun, United Provinces.

OFFICERS OF THE BRITISH EMPIRE.

Frederick Francis Ralph Channer, Esq., Deputy Conservator of Forests, United Provinces.

Adam Wilson Moodie, Esq., Deputy Conservator of Forests, Katha Divison, Burma.

MEMBER OF THE BRITISH EMPIRE.

John Ninian Oliphant, Esq., Deputy Conservator of Forests, Lakhimpur, United Provinces.

RAI BAHADUR.

Rai Sahib Nand Mal, Extra Deputy Conservator of Forests, Provincial Service, United Provinces of Agra and Oudh.

OBITUARY.

Mr. C. M. McCRIE, F.C.H.

It is with much regret that we record the death of C. M. McCrie, F.C.H., which took place at Aligarh on the 24th April last after a long illness borne with much patience and fortitude. McCrie had a distinguished career at Cooper's Hill, gaining a fellowship, and joining in the Central Provinces at the end of 1895. He served in a number of divisions but was perhaps best known in Mandla, Saugor and Balaghat. He was deputed for a time to Dehra Dun as Instructor and later became Director of the Forest School at Balaghat. As an Instructor he will be remembered by all who had the good fortune to attend his lectures and field work as a most painstaking and efficient teacher. Possessed of complete knowledge of the duties of the executive staff, he succeeded in making his teaching thoroughly practical and useful. In the course of the College tours he managed to carry out useful work for the local forest officers, as instanced by the working-plans for the Patheria and Binsar forests of the West Almora Division, which have been worked for many years in accordance with simple working-plans drawn up by McCrie and the students. The experience gained at Dehra proved of much value in the general organization of the Balaghat School, the timber collections and museum exhibits at which he modelled on the lines of those at Dehra.

Possessed of an unassuming, yet humorous, manner and of very simple tastes, he was an extremely efficient hardworking officer, as well as a keen shikari. He was

exceedingly popular with all with whom he came in contact. Although a strict disciplinarian he will be long remembered by his students, rangers and all classes of subordinates for his consideration and justice in his dealings with them.

He set an example of keen devotion to his duties and his last illness is attributable to his own conscientiousness in venturing into camp when only partly recovered from a severe chill.

His loss is irreparable and we tender the sympathy of the Department to his relatives and friends.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester*.

FOREST JOURNALS.

SIR,

I heard quite a lot about Forest Journals from Forest Officers of this Presidency last year when I was chosen as one of the delegates to the Conference at Dehra Dun in October. Nobody here was in favour of the Forest Journal as at present prescribed, and several useful and interesting suggestions were made, which I was unfortunately unable to put before the Conference as I was prevented by illness at the last moment from going.

Since then I have thought a good deal about Forest Journals, and have come to the conclusion that they should not be kept in a book at all. If the Journal is to be of any use it must be interesting, simple, and always accessible, not only on the office table but still more so in the forest. It is not easy for a book to fulfil these conditions, but they can all be fulfilled if the four-inch forest maps are used as the Forest Journal.

The object of the Forest Journal is, I take it, to have an accurate record of the state of the forest from time to time, including soil, chief kinds of trees, their quality of growth, state of

younger trees and of regeneration, undergrowth, different kinds of bamboos and remarks on their seeding and regeneration, thorny shrubs and creepers, grass with remarks on the presence of good fodder and thatching grasses, and the general state of protection indicated by such remarks as "heavily grazed," "much cut about," "frequently burnt," and so on. All these details can be shown very accurately with the help of suitable abbreviations on the four-inch maps. I am at present engaged on the revision of some of the Working Plans in this division, and one of the most important parts of this work is the selection of suitable areas for regeneration fellings and others for improvement fellings such as O and Y fellings. By making pencil notes on the maps wherever I go, I get a very accurate idea of the state of growth of these forests, which varies very much indeed from place to place. These pencil notes are afterwards inked in, with necessary modifications, and from them a short description of each compartment is written out. In my opinion there is no comparison between the notes on the map and the written description. The former show everything at a glance and on the very place and in such detail as a written description can never give.

All of us no doubt are in the habit of making notes on our maps from time to time, but I do not know whether anyone has ever done it systematically and covered his maps with notes on the state of the forest. I have only been doing it for the last year or so, but am surprised at the amount of information already jotted down in this way. Notes of this sort are likely to be of more use to a newcomer, who is bound to consult the maps, than if they were hidden away in Forest Journals which he would quite possibly never open. So let us use our maps and dispense with the Forest Journal.

A. G. EDIE,
I. F. S.

CAMP *viâ* YELLAPUR, NORTH KANARA:
31*st March* 1919.

[This subject came up for consideration at the last meeting of the Board of Forestry. As, however, the use of maps in the manner suggested by our contributor does not appear to have been before the Board, the article is specially brought to the notice of those readers who have access to the Board's proceedings.—HON. ED.]

SEED CROP OF LAC.

SIR,

I notice that Mr. Fraymouth advocates (*vide* para. 2, page 78, of the *Indian Forester* for February 1919) that the "Vaishakh" (say June) lac crop should be kept as a seed crop, and that the "Kartik" say October) crop should be the commercial one. Mr. Misra, however, states on page 9 in Bulletin No. 28 of the Agricultural Research Institute, Pusa, that "the Vaishaki crop is the larger and better" and that in some years the Kartiki crop is a partial failure. "For these reasons the growers in Bengal and the Central Provinces, who produce the largest and best kind of lac, reserve most of their Kartiki (winter) crop for seed and do not sell it."

The opinions of these two experts seem to be diametrically opposed. It would be interesting if the matter were discussed in the pages of the *Indian Forester*.

H. W. STARTE,
I. F. S.

CONCENTRIC RINGS IN SANDAL-WOOD.

SIR,

I have read with interest Mr. Troup's article on the above subject. Having had opportunities of counting rings on sections of hundreds of green sandal trees in Salem, Kurnool, Trichinopoly, Travancore and elsewhere, immediately after their fellings, I found no difficulty in distinguishing the rings in most of them with or without the aid of a lens. In some cases, the surfaces, when dry, had to be moistened with water to render the rings clear. It is true that in a few cases they were indistinct and confusing, but this is the case in most species of trees that contain concentric rings on their sections, not excepting even Teak, whose rings are generally very distinct, at any rate in this part of India. The sandal being a much slower grower and more susceptible to damage or retardation of growth by fires and other injuries than many other species, its rings are narrower and become less

distinct by the formation of spurious rings. But in the great majority of cases, the rings are annual and distinct, and may therefore be taken to represent the age of trees correctly. I would invite reference to my several notes, published in the pages of the *Indian Forester* on different occasions, soon after felling trees and taking ring countings, and to my Working Plan for Tirupattur sandalwood areas in the Salem district published in 1904.

As regards the ages of sandal-wood samples from the plantations in Mysore, referred to in para. 3 of Mr. Troup's note, I find that the data, on which he has based his conclusions, are not correct. The stocking of all the plantations given in Mr. Troup's statement was spread over a number of years, sometimes twenty years and even longer. The replacement of casualties, which were not infrequently heavy, extended over much longer periods. In some plantations, sandal was introduced long after their first opening ; thus, for instance, in *Kadagodi* plantation, the late Mr. Ricketts, then Inspector-General of Forests, wrote in his Inspection Note in December 1893 that there were 1,40,000 sandal plants of different ages, *viz.*, from 2 to 12 years old excluding that year's germination in the whole plantation. His Inspection Notes on other plantations such as Nallal, Arlemakanahalli, Old Jadigenahalli and Kurandahalli during the same year show that sandal dibblings and transplantation of seedlings were being done even then and orders were issued to conduct the same operations in felled areas and blanks, and presumably those orders were carried out later.

Besides the above source of errors, the ages of some of the plantations given in Col. 5 of Mr. Troup's statement are incorrect. Nallal and Kadagodi were selected in 1871-72 and stocking started in 1872-73 and not in 1868-69 ; Arlemakanahalli in 1874-75 and not in 1865-66 ; Bettahalli in 1871-72 and not in 1886-87 ; Kurandahalli Old in 1870-71 and not in 1888.

With the above two sources of serious errors, it is no wonder that the concentric rings on sections exceeded or were less than the ages of the plantations from which the samples for counting were taken. I am glad that Mr. Troup has " little or no doubt that

annual rings are regularly formed" in sandal. This conclusion is in accord with my innumerable ring countings and experience of sandal for over 25 years.

BANGALORE: M. RAMA RAO,
20th March 1919. *Special Forest Officer in Mysore.*

REPLY NOTE BY R. S. TROUP, SYLVICULTURIST, FOREST RESEARCH INSTITUTE, DEHRA DUN.

SIR,

The ages of the plantations as given in the statement accompanying my note referred to by Rao Sahib Rama Rao were those furnished to the Inspector-General of Forests by the Conservator of Forests, Mysore, and I can accept no responsibility for any inaccuracies regarding them. But, apart from the question of possible inaccuracies in the ages of the plantations, a comparison of the results of Mr. Marsden's ring-countings with those obtained by me will show that in several cases there were considerable differences. My own countings were made with great care on rough and smooth, wet and dry surfaces, and there is no reason to suppose that Mr. Marsden's countings were less carefully carried out. That such different results were possible can lead to only one conclusion, namely, that on several of the sections the rings were so indistinct as to give totally unreliable results: and even if the results are tolerably accurate in a fair proportion of the sections this element of inaccuracy must tell on the final results in the case of ring-countings on an extensive scale. In view of Mr. Rama Rao's extensive experience of sandal I do not for a moment doubt his statement that the rings on sandal sections are distinct in the majority of cases: at all events, I do not possess the experience of sandal necessary to pronounce an independent opinion in the matter. But considering the discrepancies between Mr. Marsden's countings and my own in respect of the sections examined if these are representative of sandal sections in general, I should hesitate to accept the age as ascertained from ring-countings without the

reservation that the percentage of inaccuracy caused by errors in counting may be sufficient to vitiate the general results in no small degree.

DEHRA DUN : R. S. TROUP,

28*th March* 1919. *Sylviculturist, F. R. Institute.*

ANOTHER SEX PROBLEM.

SIR,

A sportsman in this district had the misfortune to shoot a doe Sambhur. He paid the usual penalty, and the receipt sent by the treasury officer to the D. F. O. read as follows :—" Received from X. Y. Z. Esquire, Rupees fifty only, being the charges for accidentally shooting a female stag."

A. G. EDIE,

I.F.S.

CAMP *viâ* YELLAPUR, NORTH KANARA :

31*st March* 1919.

TIGER SHOOTING.

SIR,

Apropos to the letter on tiger shooting you publish in the February number of your Journal : I hasten to write in the hope of preventing a repetition of tactics that are almost certain to lead to disaster when dealing with wounded Felidæ. On such occasions, there will not be found wanting natives of the country to come forward to follow up, the reason I suppose being partly their own estimate of their nimbleness, but largely a lack of imagination. On the occasion, in question, one cannot condemn too strongly the sportsman's action in persisting in exposing unarmed men to danger a second time after the experience of the morning. His concluding sentence lays claim to some experience of tigers which merely transposes carelessness to culpability ! Wounded tigers must be followed up of course (not necessarily at once), but the risk should

be the sportsman's own. The use of dogs in thin cover or buffaloes in thick cover are all aids to reduce the risk. Wounded tigers are not driven by beaters, nor is the making of much noise a help when beating for unwounded ones.

I am too unwell to write further.

KAI HTUN.

EXTRACTS.

A NOTE ON SOME OF THE SHIPBUILDING WOODS OF BURMA.

BY J. D. HAMILTON, PROVINCIAL FOREST SERVICE.

1. As the question of shipbuilding is receiving something more than passing attention in Burma, a ten years' experience with some of the shipbuilding woods of the Province may be of use to those interested in the subject. It is a mistake to think that having so fine a wood as Burma teak other woods may be ignored. Teak is not the best wood which can be used in all parts of a ship and its use should be confined to the parts for which it is best suited. A judicious selection of woods would not only make for greater strength, elasticity and sea-worthy qualities but would materially reduce the cost of the vessel.

In what follows I mention only such woods as I have used myself or have had under my own observation. There may be many other woods deserving of attention and perhaps those acquainted with their qualities will oblige us with the information.

The weights of the woods and values of P are taken from Gamble's "Manual of Indian Timbers."

WOODS BEST SUITED TO THE VARIOUS PARTS OF A SHIP.

Keel.

2. *Bassia longifolia*—Bur. *Mèzè, Talainggaung* (Sandoway district).—This wood is much prized in the Sandoway district for ships' keels. It is obtainable in 50 to 60 feet lengths of 2 feet siding. The weight of the seasoned timber is about 60 lb. to the

cubic foot and the value of P about 720. Add to this that it seasons well, is very durable and is not attacked by teredo and we have all the ideal qualities for a keel.

All works on the forest flora of Burma mention this tree as only found cultivated in the province, but the tree is certainly indigenous to the Sandoway and Kyaukpyu districts. Botanical specimens taken by me in 1910 were scientifically examined at Calcutta and confirmed as *Bassia longifolia*. It was said not to have been recorded from Burma before, but the Burma Forest Act has it as one of the reserved trees of the province. This, one concludes, was some form of intelligent anticipation.

Artocarpus Lakoocha—Bur. *Myauklok* (Sandoway, *Myauk-gaung*).—Weight 40 lb. to cubic foot. P = 475. Though this timber has not the weight and strength of *B. longifolia* it is also immune from teredo. It is used for the keels of sea-going vessels built at Gwagyaung in the Sandoway district and has a very good reputation. It yields keels 50 to 60 feet long.

Hopea odorata—Bur. *Thingan*.—Weight 50 lb. to cubic foot. P = 800. This wood behaves extremely well in both salt and fresh water, but it is not immune from teredo. It yields squares 50 to 60 feet long with 24 inch siding. It seasons well and is an exceptionally strong and elastic wood and is admirably adapted for the keels of ships. Large quantities of this timber are available in the Moulmein, Tavoy and Mergui districts, and a fair amount is found in Arakan.

Lagerstræmia Flos-Reginæ—Bur. *Pyinma* (Arakan, *Kamaung*).—Weight 40 to 45 lb. to the cubic foot. P = 750. In suitable localities the tree yields 18 inch squares 50 feet long. It seasons well and, though somewhat lighter than teak, has a much higher value for P. It behaves well in both fresh and salt-water and is only sparingly attacked by teredo. I once cut the keel and planking of a wrecked brig and found the timber to be quite sound. The vessel had been in the coasting trade for over twenty years.

Xylia dolabriformis—Bur. *Pyin* or *Pyinkado*.—Weight when dry 60 lb. to the cubic foot. P = 1,000. Logs 60 feet long with

20 inch siding are procurable in most of the better forests. I have but once seen this wood used for the keel of a small brig and on one occasion I used it myself for the keel of a sea-going motor boat. Its weight and strength are very much in its favour. It also seasons remarkably well and alters very little with climatic changes. It has two disadvantages. It is loved of the teredo and is so hard that holes have to be bored to almost the size and depth of the nail or screw used. Screws often break off rather than penetrate ¾ inch of unbored wood. Heavy nails which have gone in to about an inch of the head turn over if meeting unbored wood, and it is equally exasperating to find that nails once so lodged are impossible to extract. Sometimes, too, the hardness of the wood varies in the same scantling, and nails or screws of a given size will not go home in all borings of the same size and depth. Unless this is detected before the nail turns or screw breaks there is bound to be trouble. And if you are using Chinamen they want to down tools and twang like banjos out of tune.

The wood contains much tannin and may attack iron as oak does. But oak is reckoned one of the best shipbuilding timbers in the world.

Stem and Stern Posts.

3. The same woods as have been mentioned for the keel are suitable for stems and sterns. They all yield natural crooks.

Timbers (bent).

4. These would be used only in small-sized craft such as ships, boats and launches. I have found *Saga* (Michelia Champaca) a most excellent wood for the purpose. It is light in weight, tough, seasons well and the value of P is probably about 600. It is very durable in both fresh and salt-water.

Pyinma (Lagerstrœmia Flos-Reginæ) is almost as good as *Saga*. But great care should be taken in selecting this timber as there are at times curious breaks in the continuity of the fibres which make it impossible to bend the timbers without damage. Both *Saga* and *Pyinma* receive nails well without splitting. These woods should be soaked in water for twenty-four hours before steaming if very dry.

Timbers (cut).

5. Natural crooks and bends are of course best and nothing else would be used in first-class construction.

Pyinma (L. Flos-Reginæ) probably yields the best crooks among all the Burma woods. The natural tendency of its larger limbs to grow crooked, its high value for P, and its excellent behaviour both in fresh and salt-water leave little to be desired.

Thousands of crooks are cut every year in Arakan for use in local craft and for building brigs at Chittagong. As often as not the builders do not trouble to remove even the sap, yet they last remarkably long.

Other woods which yield good crooks are teak (Tectona grandis) when on poor soil, *Saga* (M. Champaca), *Thingan* (Hopea odorata), *Padauk* (Pterocarpus macrocarpus), *Ponnyet* (Calophyllum Inophyllum) and of course *Pyinkado* (Xylia dolabriformis). The last yields an infinite variety of excellent crooks of phenomenal strength and elasticity. But then there is the nail trouble mentioned before. Some day the difficulty will be overcome and we shall then have for use a stock of the finest crooks, bends and knees in the world. But as a caution I might mention that on the southern shores of Sandoway there is a roving lunatic who, the boat-builders at Gwagyaung say, went off his head when only half way through with a cargo boat in which he had placed *pyinkado* ribs.

Deadwoods.

6. *Thingan* (H. odorata), *Pyinma* (L. Flos-Reginæ), *Talaing-gaung* (B. longifolia), Teak, *Pinlèkanazo* (H. Fomes), *Padauk* (P. macrocarpus).

Gunwales, Inwales, Shelfs, Stringers.

7. *Thingan*, *Padauk*, Teak, *Kashi* (Pentace burmanica), *Saga* and *Pyinma*.

Deck Beams and Carlines.

8. *Thingan*, *Pyinma*, Teak, *Pinlè-kanazo Padauk*, *Saga* and *Kashit*.

Planking.

9. Teak is the finest all-round wood for the purpose Its sterling qualities are known the world over. Lloyds give the most favourable terms for vessels planked with teak and it is as well to reckon with them if the vessel is intended to be insured. The further great advantage

of dealing with teak in Burma is that, owing to precautions taken by the Forest Department, nothing but seasoned timber ever gets on the market. Moreover, from the large quantities available perfect planks of almost any requisite length can be obtained. One cannot go wrong in using first class Burma teak. It is unfortunate that it is not quite immune from teredo and that it is so very expensive, but it would not be so good at a lower price. In buying selected teak planking one procures the finest and best seasoned wood in the world.

Pyinma (Lagerstrœmia Flos-Reginæ).—If this wood is carefully selected it makes very excellent planking indeed. It is very durable in both fresh and salt-water and is less attacked by teredo than teak. In Arakan and Chittagong they use nothing but *Pyinma Kamaung* or *Farul* in planks anything up to three inches thick. I have seen vessels with sound planking which have had the roughest of rough use for twenty years—six months in the water and six months on the hard. I do not know how the timber acts in contact with iron, but it contains nothing obviously inimical to this metal, and in parts where it has been in use for ages one hears of no ill report. Many forests in Burma yield very fine *Pyinma* logs. The tree favours the rich valleys in the hilly parts of Lower Burma and Arakan and this makes extraction fairly easy compared with many other woods. The timber seasons well when girdled, but the planks should be carefully selected as there are at times flaws in the wood owing to fibres not anastomosing in the usual way. Logs with heavy burrs are not suited for planking though they yield very handsome panelling.

Artocarpus Lakoocha—Bur. *Myauklôk* (Sandoway, *Myauk-gaung*).—This is another good wood for planking. It is freer from flaws than most woods and is said not to be attacked by the teredo borer. It seasons well but is unfortunately not very common. The tree attains a very large girth and a single log is capable of yielding a large number of sound planks. The timber is largely used in parts of Arakan.

Hopea odorata—Bur. *Thingan*.—This is a most excellent wood for planking. It is tougher and stronger than teak and very

durable both in fresh and salt-water. I have always found it to be of very even quality, to season easily, and to vary very little with climatic changes. It is not immune from teredo but suffers no more than, if as much as, teak.

Pentace burmanica—Bur. *Kashit* or *Thitka*.—Weight 40 lb to the cubic foot. P = about 600. It is about as hard as teak. This is a beautiful wood for ships' boats and launches. I once used it for planking a motor launch and was very pleased with the results. After five years of rough usage in fresh and salt-water and in the mud of mangrove the creeks the wood showed as fresh and as sound as on the first day. There were a few pin-holes from teredo attack which showed that the timber was not immune from this pest.

Kashit logs are of very even quality and often of considerable size. I have seen logs over sixty feet long and ten feet in girth in the Sandoway district. The tree is fairly plentiful on the higher levels throughout Lower Burma. It seasons well when girdled and is not much affected by atmospheric changes. It is suitable for sawing into thin planks for what is known as the multiple-skin construction of the hull and was used by me in this form.

Michelia Champaca—Bur. *Saga* or *Taungsaga*.—Weight about 37 lb. per cubic foot. P for Mysore wood is quoted by Gamble as 642 and for Nepal wood as 561. No experiments appear to have been performed with wood from Burma. Taking the value of P for teak as 575, I certainly think that for *Saga* would be as much if not more. It makes excellent planking for boats and launches and is very durable in both salt and fresh-water. I have seen it used for sea-going cargo boats in Arakan, and it has the reputation of being very little affected by teredo. The tree belongs to the moister and higher levels. It is not common but attains a very large size. There are very few defects in the wood and almost every log yields a very high percentage of beautifully even planks. The timber may be sawn into planks green and then allowed to season in the shade. In about a year or 18 months the planks will be found to vary very little when put in place. *Saga* is a handsome wood and not unlike teak in appearance.

Artocarpus Chaplasha—Bur. *Taungpeinnè*.—Weight about 40 lb. to a cubic foot. The quality of this timber varies very much with the soil. Where it grows with a straight clean fibre it is a very fine planking wood and has great lasting qualities in both fresh and salt-water. The tree grows to a great size and seasons well. I have only seen the planking used for small sea-going craft. It makes excellent planking for boats and launches, and works and finishes in a very pleasing manner.

Before leaving the question of planking, I would venture to offer a suggestion to guard against teredo since copper sheeting has become little more than a memory of former times. I once came across an observation in an American journal that teredo did not pass out from one piece of wood to another even when closely in contact. I accordingly took to examining the piers and bridges in the Sandoway and Kyaukpyu districts, and repeatedly found that teredo which had got into the struts never passed into the posts, though it had eaten the struts to wafer thinness where in contact with the posts. In the multiple-skin boats I built, the teredo pin-holes in the outer layer never passed into the inner planking. I am accordingly inclined to believe that teredo will not pass out from one plank to another even if in close contact. If therefore a ship's planking were to be overlaid with another layer of, say, one inch planks below the load water line, much, if not total, immunity would be secured for the true hull of the ship. To add further to this security I would suggest the protecting wood be of a species known to resist teredo. Of all such woods Fagræa fragrans, Bur. *Anan*, stands first. At Tavoy there are posts which have stood in water from two to three hundred years unattacked by teredo. The weight of the wood is about 60 lb. to the cubic foot, and the value of P is *probably* about 550—though it needs to be redetermined as it seems too low and some experiments have shown as much as 980. Large quantities of *Anan* can be obtained from the forests between Moulmein and Tavoy. When putting on the outer skin, the opportunity could also be taken to place a layer of heavy pitch-soaked sacking or other such material underneath this skin and so render the vessel

all the more water-tight. If this second skin is laid diagonally to the first it also adds enormously to the strength of the hull.

Deck.

10. The woods mentioned for planking are all suitable for this purpose, and I would add *Padauk* (P. macrocarpus) where a light-coloured deck is not a *sine quâ non*.

Coamings.

11. Teak, *Thingan*, *Padauk*, *Pinlèka-nazo*.

Covering boards.

12. For small craft, ditto.

Thwarts and seats.

13. Teak, *Rashit*, *Thingan*, *Taung-peinnè*, *Padauk*, *Pyinma*, *Saga*.

Bulk-heads.

14. Much depends on the nature of the bulk-head required. If it is also intended to stiffen the ship or likely to be subjected to rough usage in handling cargo, *Thingan*, *Pinlèkanazo*, Teak, *Pyinma* and *Padauk* are suitable woods. For lighter purposes and mere partitions, *Kashit*, *Saga*, *Taungpeinnè*, and even *Thitkado* (Cedrela Toona) could be used with advantage.

Flooring.

15. The woods suitable for decking are also suitable for flooring, though it is customary to use a lighter wood for flooring where heavy cargoes are not concerned. In such cases *Pyinma*, *Saga*, and *Kashit* could be used with advantage.

Floors or floorbearers.

16. These are best made of a tough elastic wood—*Pinlèka-nazo*, *Thingan*, *Pyinma*, answer the purpose perfectly.

Rudder.

17. Rudders on large vessels are usually of metal. But if wood must be used metal should not be stinted to stiffen the structure. It is impossible to get wood with the fibres running to suit all the strains to which a rudder is subjected. In the Sandoway district and other parts of Arakan where metal is not easily procurable, rudders are often cut in a single piece from the great buttresses given off by *Thitpok* (Tetrameles nudiflora) and for smaller craft from similar growths found on *Pinlèôn* or sea-cocoanut (Carapa obovata). The latter is a very strong, heavy, and durable wood,

but the former is light and perishable and needs constant renewal. These makeshifts for the more primitive types of craft show how difficult it is to make strong rudders without the liberal use of metal.

The woods suitable for built up rudders are—*Pyinkado*, *Thingan*, *Pinlèkanazo*, *Padauk*, *Talainggaung* and *Pyinma*. For the rudder post any of the first four and for the steering wheel *Padauk*, Teak, *Thingan*, or *Pinlèkanazo*.

Masts.

18. There always seem to the difficulties in procuring good masts, and yet Burma contains most excellent woods for the purpose. For large vessels I place them in order of importance:

Thingan (Hopea odorata), *Pinlèkanazo* or *Yezo* (Heritiera), *Pyinkado*, *Talanggaung* (Bassia longifolia), *Teak*, *Tharapi* (Calophyllum spectabile), *Pyinma*. I have seen every one of these woods in use and they answer their purpose perfectly. The idea of *pyinkado* for masts may strike one as rather unusual. The name of iron-wood, its extreme hardness and green weight all lead one to suppose that it is inordinately heavy for the purpose. And yet its weight when dry is about 60 lb. to the cubic foot whereas *Pinlèkanazo*, which is often used for masts, averages 67 lb. to the cubic foot. Seasoned *Pyinkado* from rich soil where its growth has been quick is often not more than 55 lb. per cubic foot and I have seen it floated out in the Sandoway river in rafts like teak. I have seen similar light *Pyinkado* which had been killed in *taungyas* (hillside clearings) at the head-waters of the Môn and Kyaukkyi streams in the Shwegyin district. As the behaviour of teak is so well known I give comparative figures indicating what may be expected from a *Pyinkado* mast of the kind mentioned.

Teak lb. per cubic foot 45—50, P=575. E=3,600.
Pyinkado lb. per cubic foot 50—55, P=1,000. E=4,150.

This shows the enormous strength and elasticity of a *Pyinkado* mast. For small vessels requiring light and elastic masts *Pyinma*, *Tharapi* and *Thitmin* (Podocarpus neriifolia) are suitable.

Cabins and cabin fittings.

19. Woods light in weight and of handsome grain are naturally desired. But they must at the same time be woods which vary little with

climatic changes and last long. Burma has a long list of such woods. I here only mention a few which I know can be used with every confidence.

Kashit (Pentace burmanica).—Light red. Not unlike mahogany.

Thitkado (Cedrela Toona).—Known as "Moulmein Cedar" on the English market.

Saga (Michelia Champaca).—Light olive-brown. Very handsome. Somewhat resembles teak.

Taungpeinnè (Artocarpus Chaplasha).—Yellow to brown. Gives a very pleasing effect with *Kashit* or *Thitkado.*

Thitmin (Podocarpus neriifolia).—Yellow or yellowish grey. Takes a beautiful polish.

Pyinma (L. Flos-Reginæ).—Reddish. Logs with burrs produce a very handsome grain.

Yemanè (Gmelina arborea).—Yellowish or greyish. Takes a very fine polish and can be stained to any colour.

Maniawga (Carallia lucida).—Red with beautiful silver grain. Makes very handsome panelling. Somewhat heavier than above woods and about the same weight as teak.

20. In the table of woods given below the values are quoted largely from Mr. C. G. Rogers' work on "Forest Engineering," Volume I, and Mr. Gamble's "Manual of Indian Timbers."

In the former work the formula for obtaining P, or the *coefficient of transverse strength,* is given as—

$$P = \frac{W \times L}{b \times d^2}$$

where P is expressed in pounds Avoirdupois.

W = the breaking weight, or the weight in lb. which, when placed on the middle of the bar, causes it to break.

L = the length of the bar between supports *in feet.*

b = the breadth of the bar *in inches*

d = the thickness of the bar *in inches.*

ty E_d is obtained from the formula—

$$E_d = \frac{L^3}{bd^3} \times \frac{W}{x}$$

where L = the clear distance between the supports *in feet.*

b = the breadth of the beam *in inches.*

d = depth of the beam *in inches.*

W = weight supported at the centre of the beam in lb.

x = the maximum deflection of the beam *in inches* without causing appreciable permanent distortion.

To the table have also been added a few woods largely used in Europe for shipbuilding to enable those familiar with their use to get a more practical idea of our Burma woods.

Burmese name.	Botanical name.	lb. per cubic foot.	Value of P.	Value of Ed.	Crushing weight.	Purpose for which best suited.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Anan	Fagræa fragrans ...	60	550	...	9,200	See planking.
Kashit or Thitka ...	Pentace burmanica ...	40	570	...	...	Planking and cabins.
Kyun (Teak)	Tectona grandis ...	45— 50	575	3,600	15,482	Planking and decks.
Maniawga	Carallia lucida ...	46	700	...	...	Panelling cabins.
Myauklôk or Myaukgaung	Artocarpus Lakoocha ...	40	475	...	...	Keels, and planking.
Padauk ...	Pterocarpus macrocarpus ...	60	800	4,180	19,036	Deck and flooring.
Pinlèkanazo or Yezo ...	Heritiera Fomes ...	64	900	3,726	29,113	Masts and floors.
Pyinkado	Xylia dolabriformis ...	60	1,000	4,150	16,657	Masts and rudders.
Pyinma	Lagerstrœmia Flos-Reginæ	40— 45	750	3,665	15,388	Planking, decks, masts, timbers.
Saga	Michelia Champaca ...	37	560	3,360	...	Planking timbers.
Talainggaung or Mèzè ...	Bassia longifolia ...	60	720	...	..	Keels, stems, sterns.
Taungpeinnè	Artocarpus Chaplasha ...	35	460	.	...	Planking and cabin.
Tharapi	Calophyllum spectabile ...	39	530	..	...	Masts.
Thingan	Hopea odorata ...	50	800	3,660	22,209	Keel, planking, decks, masts.
Thitkado	Cedrela Toona ...	35	465	3,126	9,000	Panelling, lockers.
Thitmin	Podocarpus neriifolia ...	40	588	...	...	Masts, cabins.
Yemanè	Gmelina arborea ...	36	375	2,132	...	Cabins and furniture.
	Woods used in Europe.					
Oak	Quercus pedunculata ...	58	560	3,925	6,400	Timbers. planking.
Larch	Larix europæa ...	37	629	3,700	..	Planking.
Mahogany ...	Cuba	48	642	...	...	Planking small craft, cabins and furniture.
	Honduras	41	601	...	...	
	Mexican	42	587	...	...	

21. In procuring timber for shipbuilding the greatest care should be taken to see that no mistake is made about the kind of wood supplied. It is not easy, even after considerable familarity, to say with certainty that a particular wood is really what it purports to be. The only safe method is to compare the wood with Gamble's description and *at the same time with a known sample of the wood.* In case of uncertainty it would always be advisable to get the opinion of a forest officer who had studied the subject. It is not always safe to depend on the local carpenter or other such timber expert. I have known them make some very bad mistakes. Ships are expensive to build, so I shall mention two cases in which the wrong timber was supplied, and accepted, to show how easy it is to go wrong.

The Forest Department once recommended *Anan* (Fagræa fragrans) to the Public Works Department for bridge piles knowing the timber to have stood the test for two or three hundred years. The Public Works Department were supplied by a contractor with a wood which perished in a couple of years. They were naturally very angry with the Forest Department. On enquiry it was determined that the wood the Public Works Department got was not *Anan* (Fagræa fragrans) but *Anauk* (Crypteronia pubescens), the timber contractor explaining that he thought one kind of *Anan* was as good as another.

At Sandoway I found a contractor had been supplying the Assam-Bengal Railway with three kinds of *Pyinkado* sleepers—Black, White and Red. The Black was *Taukkyan* (Terminalia tomentosa), the White—*Yon* (Anogeissus acuminata), the Red—*Pinbye* (Eugenia *spp.*). There was never any real *Pyinkado* (*Xylia dolabriformis*). What actually happened in Assam or Bengal I do not know, but when the Forest Department some years later undertook the supply of sleepers the Railway were very insistent with their demand that every sleeper should bear a Forest Department hammer mark as a guarantee that the wood was *Pyinkado*. The former colour scheme (Black, White and Red) had evidently not come up to expectations.

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NOTE ON MR. HOLE'S PROPOSED SYSTEM FOR THE REGENERATION OF SAL FORESTS.

BY B. R. WOOD, I.F.S.

PART I.

In the *Indian Forester* for March 1919, page 119, *et seqq*, Mr. Hole contributes a most interesting and suggestive article on the regeneration of Sal Forests, and puts forward suggestions for a new system of management of Sal forests, based on the results of a long series of experiments carried out on the regeneration of Sal at Dehra Dun. In the course of his article he considers shortly a number of possible objections to the system he advocates. It might be of interest to elaborate some of these objections, and to raise one or two more which, though not mentioned in the article, might have a bearing on the success, or failure, of the new method.

In three of the five possible objections with which he deals (*viz.*, *b*, *d* and *e*), the necessity of a suitable organization of labour is mentioned, whilst objection (*e*) is that "The system requires

more labour than is likely to be available"; and this is got over by reducing the amount of work to be done in June and early July, when labour is most difficult to obtain to the broadcast sowings. The first and second weedings would then, presumably, be done at the end of the rains, and the hoeing during the cold or hot weather. The establishment of forest villages is suggested as a means of increasing the available labour supply. It is interesting, in this connection, to try and work out very roughly the amount of labour which would be involved in applying this system to an average Sal division in the United Provinces.

Mr. Hole advocates strips about 60 ft. wide. For the sake of simplifying the calculations, this width may be taken as 66 ft. or 1 chain. As present knowledge goes, 150 years is a fair average rotation for Sal, rather high if anything; whilst the Sal divisions at present average not less than 200 sq. miles. The regeneration period is 15 years. This 15 years in 150 gives us $\frac{15}{150}$ = 1/10th the total area under regeneration. In the average division of 200 sq. miles this is $\frac{200}{10}$ = 20 sq. miles, $20 \times 640 = 12{,}800$ acres under regeneration by strips. As the strips are 1 chain wide, each acre under regeneration involves a length of 10 chains or $\frac{1}{8}$th of a mile of strip. Hence $\frac{12{,}800}{8} = 1{,}600$ miles of strip. On each patch to be regenerated in the 15 year period, four operations at a minimum are necessary: (1) Hoeing, (2) Broadcast sowing and collecting seed, (3 and 4) Two weedings. Hence each year $\frac{4}{15}$ of the area must be worked on $\frac{4}{15} \times 1{,}600 = 425$ miles of strip roughly of which $\frac{425}{4}$ = 106 miles are to be actually completely hoed up. Looked at in this light, it appears that the labour problem is one which it will be difficult to dismiss in two short paragraphs. It might, then, be worth while to examine, shortly, the conditions prevailing in one or two areas in Agra and Oudh. The Thano forest is an area of roughly 5,000 acres, situated in one of the most densely populated areas of the Dehra Dun flanked by the Markham, Jeoli and Lyster grants with the large villages of Thano and Bhogpur towards the

side facing the hills. In November-December 1918 the utmost difficulty was experienced by the sylviculturist in obtaining labour to weed and tend his experimental plots alone. The South Patli Dun in the Kalagarh Division is an area of grass-land central for a very large area of Sal forest, bounded by the Mundal and Palain valleys, the outermost Siwalik ridge and the Ramganga-Kosi watershed, comprising the Adnala, Kanda and South Patli Dun Ranges. It is practically uninhabited. Here is a case for the establishment of forest villages. For a number of years past, continued attempts have been made to establish a forest village here on almost any terms, the result up to date being complete failure. Yet under the new system, not one, but several villages would be required; and, in addition to the work of fire-protection, road-work, etc., the villagers would be required to turn out at three seasons of the year to hoe, sow and weed many miles of strips. I can vouch from experience, of the extreme difficulty of obtaining and keeping till May only 72 coolies, for enumeration work, in these parts.

In Oudh I am less familiar with the conditions, but in 1917-18, in North Kheri Division, the greatest difficulty was experienced in obtaining labour for the clearing of roads and lines alone. The establishment of forest villages here would again offer difficulty. Either large areas of very valuable forest would have to be cleared, or else the villages would have to be established in the Phantas, a matter of great difficulty if the experience of crop raising to eradicate grass in the Sarota Phanta is to be accepted as a typical case.

If then we take the rough average figures I have given and apply them to the Bahraich, N. Kheri, Haldwani, Ramnagar, Kalagarh, Lansdowne and Dehra Dun divisions, we have seven divisions with 425 miles of strip in each to be worked each year or 2,975 miles of strip. The expenditure involved in this for a return 150 years hence, when the lowest rate at which Government can borrow money, even at forced rates, is 4 per cent., *i.e.*, General Provident Fund—may well make the Financial authorities turn longing eyes towards canal projects, with their relatively quick

returns and eight per cent. profit. Gorakhpur Division has been left out of this, as it may be said that the Sal there approximates more to the Bengal-Assam type, also the smaller Sal divisions.

This leads on to the control and supervision of the work; and it is pertinent here to examine the experience which has been gained in this province by sowing and planting on a large scale. We can take the two large Sal nurseries at Ramgarh and Banki in Gorakhpur, and the work in the Etawah and Afforestation Divisions. The two big Sal nurseries mentioned occupy an area of several acres each. Ramgarh is quite successful and Banki very much less so; and the commonest reason given is that constant and continual supervision is necessary during the rains. Mr. Howard, formerly D. F. O., Gorakhpur, has stated that he considers it necessary for the D. F. O. personally to visit each nursery *once a week* throughout the rains for success, to be certain; and he attributes the success at Ramgarh and the comparative failure at Banki to the fact that while the former is accessible from head-quarters during the rains, the latter is not. The afforestation work in Etawah and the Afforestation Division yields much the same experience, it being considered necessary for the D. F. O. to go completely round each division once a month throughout the rains, for success to be attained.

Mr. Hole's strips are, roughly, 60′ × 180′. If we take them as 66′ × 198′, we have them 1 × 3 chains or approximately $\frac{1}{3}$rd of an acre each. Reverting to the 12,800 acres under regeneration in the average division we have, therefore, 12,800 × 3 = 38,400 strips in each division. On each strip there are to be three areas to be regenerated, and each area requires four operations (hoeing, sowing, and two weedings). Assuming both weedings can be inspected together, we then have on each strip each 15 years 3 areas with three operations on each. That is, in any given year, work will be done on $\frac{9}{15}$ of the strips or $\frac{38,400 \times 9}{15} = 7,680 \times 3$ and these operations take place at three different seasons of the year: sowing at the break of the rains, weeding at the end of the rains and hoeing in the cold or hot weather. If the D. F. O. visits each strip once

for each operation, he will have to go round his division three times a year and each time inspect 7,680 strips, or over 200 a day if he takes a month on each trip and works on Sundays. At the risk of repetition it cannot be too strongly urged that the only hope of success in this work is continual personal inspection by the D. F. O. As the receipts and issues of correspondence in N. Kheri Divisional Office already total, I believe, some 15,000 a year and there is plenty of work in the jungle as well, this prospect is more likely to infect D. F. O.'s with Satyagraha than cause them to sing a Hallelujah chorus.

Another, and perhaps less important, objection is the difficulty of extraction. If the system involves the laying of strips in a definite direction, the strips must, in many cases, be laid across the natural lead from stump to road, and in countries much cut up by nullahs and ravines this is a consideration. We cannot, for very many years, lay out a system of "Black Forest" roads on which to base our strips. The direction of the strips at Schönmunzach in the Black Forest has been modified partly for this reason and stress is laid on it there. In this connection it is interesting to note that, although the area of the division is only about 6,000 acres and each kind of felling in the strip is about 70 feet, yet the D. F. O. said that, although he did not know the exact length of strips in the division, it was more than 150 miles, and was more than one man could properly supervise, and there is neither hoeing nor sowing there.

A sylvicultural point also arises. Page 129 (*b*) and (*c*). The width and the strips to be three-fourths the average height of the forest. Only alternate strips to be regenerated first. The intervening strips to be left till the young growth has attained the original height of the forest. Consider our forest with a rotation of 150 years, after the system has been in force for 75 years. Half the area is now regenerated, *i.e.*, *every alternate strip*. Now a dilemma occurs. It must either be assumed that the full height-growth is completed in half the rotation, and that for the last 75 years of their life the trees do not grow in height at all, a very difficult assumption indeed, or we must suspend operation until the young strips have

attained their full height-growth, again very difficult, involving, as it does, a grave departure from the normality of the forest, or else we must now *reduce the width* of the remaining strips to make them conform to the reduced height of the side-shelter trees, a most complicated thing to put into practice, as, if it takes the same time to regenerate the narrower strips, as it did the wider ones, we are left at the end of the rotation with a very large number of very narrow strips of mature trees.

Any system for managing Sal involving the production of even-aged crops must, at present, be capable of being applied to irregular forest to convert it. If it cannot do so, then it cannot come within the bounds of the practical politics of the present century. It would, therefore, be interesting shortly to examine the considerations which have governed the prescriptions of "conversion to uniform" Sal working-plans in the past, and see how far Mr. Hole's system either conforms to those considerations, or justifies a departure from them. The two prime necessities are: (1) to make regeneration as certain as possible, and (2) to avoid a heavy sacrifice of growing stock. The second of these takes advantage of the fact that, in all irregular forests, over certain areas old trees preponderate, whilst over other areas the average tree is young, and the area has generally been chosen for Periodic Block I or Quartier Bleu which has the highest proportion of overmature and mature trees, and with regeneration already established [*e.g.*, Thano, Haldwani, Gorakhpur]. Under Mr. Hole's system the first consideration goes, as he can rapidly obtain regeneration whether it is already there or not. This gives the consideration of sacrifice of the growing stock full play, and with the system under discussion it appears that this sacrifice will be very great. The strips have to be about 60 ft. wide laid in a certain direction, alternate ones being regenerated, the rest being left for a very long time. The areas cannot then be chosen with any reference to the condition of the existing crop. If the oldest areas be chosen first, then alternate strips will be nearly two rotations old before they are felled, involving heavy loss. If this be avoided by choosing younger crops, then the old crops are becoming overmature and

the evil day is only being postponed, while heavy sacrifice is involved in felling younger crops. In any case, strip fellings must occur on the whole area in half the rotation, and the realisation of mature trees in the shelter strips will be a matter of difficulty, involving either a very short felling cycle and very light and scattered fellings, or else more concentrated fellings with the danger of reducing the height of the shelter strips.

The regulation of rights in forests open to grazing may offer difficulties.

As regards the collection of seed, it would be interesting to compare germination tests with seed collected for the experimental plots, with the care usually bestowed on this work, with seeds collected by coolies, and brought, say six miles in a June sun. This lead is quite enough, very often, to make Sal seeds in a sack ferment to such an extent that the germinating power is materially reduced.

PART II.

Mr. Hole's system for Sal regeneration marks a very long step forward on anything that has gone before, in that he shows, as far as experimental evidence can show, that by means of it the average Sal forest of Northern India can be regenerated in a short period with reasonable certainty. He argues that it is not a good thing to regenerate Sal forests under shade, as nature does, on account of the very long regeneration period required, due to the small percentage of seedlings which establish themselves, and the very long time taken by a seedling to attain the necessary height of $3\frac{1}{2}$ feet before the overwood can be removed : and it is possibly here that his critics will join issue with him. The fifty year period required is based on the rates of growth of observed seedlings of known age growing under shade in experimental plots, the first results from which were obtained in 1912, probably after three or four years' experimenting, so that the experiments will now be about ten years old. But ten years is only one-fifth of the period claimed to be necessary, and no evidence is adduced in the article in question to show that the rate of growth is constant and comparable to that of the first ten years, during the remaining

forty years of the period ; nor that the removal of the cover, say after 25 years, will react on the seedlings in the same way as the removal of the cover after ten years. In the article quoted little reference is made to the phenomenon of dying back which is so constantly observed with Sal seedlings in a natural state. Troup however [note on European sylvicultural systems, p. 70] mentions, with reference to these experiments, that Sal seedlings have been obtained, *which have not died back* (the italics are his), and the inference is that the rates of growth quoted, apply to seedlings which have not died back. It seems very probable that in nature the average exploitable Sal tree died back several times before establishing itself, and the question now arises whether it would not be worth while to adopt a Shavian Paradox as a basis of further experiments, and instead of finding out how to prevent the Sal dying back, find out, so to speak, how to make it die back.

In the average Sal forest of Northern India as at present constituted, the average Sal seedling probably lives on for a number of years, dying back periodically, but all the while storing up more and more food material in its roots, or at any rate building up a big root system out of all proportion to the above ground shoot, until a fortuitous combination of circumstances gives it its chance to go through, when it shoots ahead with amazing rapidity, and, for a few years, may even put on three and four feet in height growth a year. Such Sal seedlings are a common sight in any of the submontane forests of the U. P., and overhead clearance is probably what gives it its chance as much as anything else. The rate the Sal shoots up in the cleared areas, under the Gorakhpur system, is well known, and *always barring the frost danger*, it would probably do so elsewhere as well. Near Nishangarha in Bahraich it is, in many places, doing so where clearances have been made. It is quite a feature of the good type of forest near Chandanpur in Gonda. It is quite commonly doing so in the cleared areas of Periodic Block I at Thano in the Dehra Dun ; whilst it is a marked feature of the Group "A" fellings in the "conversion to Uniform" circle in

Ramnagar, both near Hathigaliar and in the Kumeria Block. Here the overhead cover was lightened, 40 to 50 per cent. of the trees being removed, roughly in groups with the idea of helping existing regeneration and obtaining more. Last year's seed year gave practically no regeneration on these areas at all, although it gave much in group "B" under shade, but the regeneration which existed there previously has made an extraordinary response. In fact the clearance has stimulated the Sal to that sudden upward rush mentioned before.

We cannot, however, make complete clearances over this area because of frost. It is, however, at least possible that some system of strip fellings over already established regeneration, which has been dying back for some years under shade, might provide a solution. The shelter strips being very narrow, so that they could be removed before the surrounding young stuff has attained a great height, just sufficient to protect a very narrow strip from frost.

We would then have to find out the factors governing this wonderful spurt the Sal makes after dying back for some while, and endeavour to reproduce those factors. Could we do so, reducing frost, and giving the seedlings the most favourable light conditions, by means of some form of strip fellings, regenerating our failures by Hole's method, we have practically overcome the labour and supervision difficulties, as well as the sylvicultural difficulties mentioned in Part I of this article. At least there is only the weeding left, and once the Sal starts going ahead, that is not too heavy a matter.

It may be argued that this does not reduce the regeneration period from fifty years to fifteen, but in reality it does. We can commence regenerating under full shade, fifty years before the crop is due to move into Periodic Block I if necessary, and if when that crop enters Periodic Block I and we remove our trees at the age of maturity we can make our regeneration go straight ahead, we have in reality reduced the regeneration period. What we have to do then is to remove the old crop in such a way as to obviate frost damage and cause the Sal regeneration to shoot ahead.

My suggestion then is that we should now find out, by experiment, the factors governing this upward rush of the Sal, which has been dying back periodically under shade, so that we can remove an old crop in such a way that, in areas where frost is a factor, we can still get the Sal to go ahead undamaged, and this, probably, by removing the overwood in strips; but with as great certainty as it now goes ahead in Gorakhpur, after clearances in areas where there is no frost. And if the fires of controversy can fine down these suggestions to something which can be tried experimentally, my Easter Bank Holiday will not have been as sadly wasted as I feared this morning it might be.

B. R. WOOD.

Note.—This article reached us just as the Forest Botanist was about to depart from Dehra on furlough and there was not time to obtain a reply to Mr. Wood's criticism. Mr. Hole, however, left notes on the main points as follows:—

"*Labour.*—Owing to the advance growth now more or less existing in practically all our forests it is probable that, on an average, only about ¼ to ½ the total area will have to be actually hoed and sown. If labour proves so great a difficulty as Mr. Wood anticipates, there is no reason why we should not continue to get this advance growth by judicious burning. It is also probable that the establishment of advance growth will be assisted by the side-light given to the unworked strips when the alternate strips are felled.

Apart from this, however, I feel sure we ought to do more by organizing permanent labour corps similar to those found so useful in grass work.

Inspection.—This has certainly been overstated. One of the reasons for constant inspection by the D. F. O. now is that the work has not yet become of a sufficiently routine nature to allow of its being entrusted to subordinates. Judging from the broadcast sowings at Lachiwala, one inspection annually by the D. F. O. should be enough.

Extraction.—There is no necessity for the export roads to keep strictly to the strips, while confining the fellings to definite

strips must make extraction easier than in the selection, group or compartment systems.

Width of strips should be calculated on height of forest at half the rotation, thus :—

Rotation 150 years.

Height at 75 years = 80′

Width of strips—$\frac{3}{4}$ of 80 = 60′.

The alternate strips would then be regenerated when the original strips are 80′ high, *i.e.*, 75 years old.

This has been explained in the Forest Record now in the Press.

Sacrifice.—During the first rotation all promising pole crops would be kept. The alternate strips would be managed under light improvement-*cum*-selection fellings (as is being done at present) until they are regenerated. Such fellings would not reduce the average height of the forest below 80′.

Mr. Wood finally suggests that the factor responsible for dying back should be investigated—all our experiments indicate that it is primarily unsuitable conditions of soil aeration and moisture which can be improved by suitable fellings."

[In our opinion, there are also important considerations which the author of the system has not dealt with as regards the effect on the growth of the young Sal located at the edges of the narrow strips. It would seem natural to suppose that the portion of the young crop situated in the centre of the strips would eventually get well ahead of that growing at the sides. Would it be necessary to wait until the edge trees had reached a height of 60 ft. before commencing operations on the remaining strips? The system would appear to retard the growth of the regeneration at the edges of the strip and would perhaps result in a very uneven rate of height-growth. The quantity of seed to be collected in order to deal with even a quarter or half of the area under regeneration is also very large; and as may happen when the seed crop fails completely, difficulties may arise in making up arrears. We hope to find all these objections fully traversed in the monograph recently completed by Mr. Hole and which we hope to see published shortly.—Hon. Ed.]

RESERVATION OF STANDARDS IN STRIPS AND CHECKS IN EXPLOITATION.

In the Bombay Presidency, the general method of reserving and numbering standards in areas worked under the coppice-with-standards system seems hitherto to have been by groups more or less scattered through the coupe. Hence great difficulty was experienced when checking standards during the working or at the expiration of a contract. Sometimes, it used to take half an hour to check some 10 standards. It is, therefore, obvious that all the standards in a coupe were rarely checked before charge of the coupe was taken back from a contractor, and the Ranger had, by force of circumstances, to sign a false certificate of checking, for in one year's coupes he might easily have 30,000 standards. Under these circumstances, reservation in parallel strips was adopted. The writer does not lay claim to be the originator of the idea, but merely takes this opportunity of describing how it is worked out in the North Khandesh Division.

2. First of all, the reserving officer marks the necessary standards in a strip 33′ wide round the coupe, starting at any convenient point, say, at cairn No. 1 (see sketch map below) putting on tar bands at breast-height, and writing serial numbers with tar on shal-

blazes so as to face him as he goes forward; then he takes in hand a strip approximately 33′ wide parallel to any side; and when he has finished this strip, he returns in the opposite direction reserving the standards in the next strip about 33′ wide and parallel to the strip just finished. In this way he proceeds through the coupe, the numbers in alternate strips facing in opposite directions. In practice this method of reserving standards in parallel strips is found to take no more time than by groups, as the whole area has to be walked over whichever manner is adopted; and an advantage is that standards are almost automatically evenly distributed.

3. When filling up the register of standards, the marking officer makes a note as to the exact position of the number of

the tree which begins and ends any one strip, *e.g.*, "opposite standard No. X in the first boundary strip"; hence, if an inspecting officer wishes to check any specified tree he knows exactly in which strip to look for it; and since the numbers in each strip are all written so as face one way and go in serial order as one proceeds forward in the strip, the officer can soon come across the exact location of the tree looked for. When in the right strip, and looking for a special number he does not trouble to look to the right or left at trees which show only tar bands facing him, for he knows that their numbers must be on the opposite sides of the trees and that they are therefore in the next strip. In this way he knows that a given tree must be within the limits of its strip and between its backward and forward serial number. Under this system, it is easy to check 200 standards in an hour.

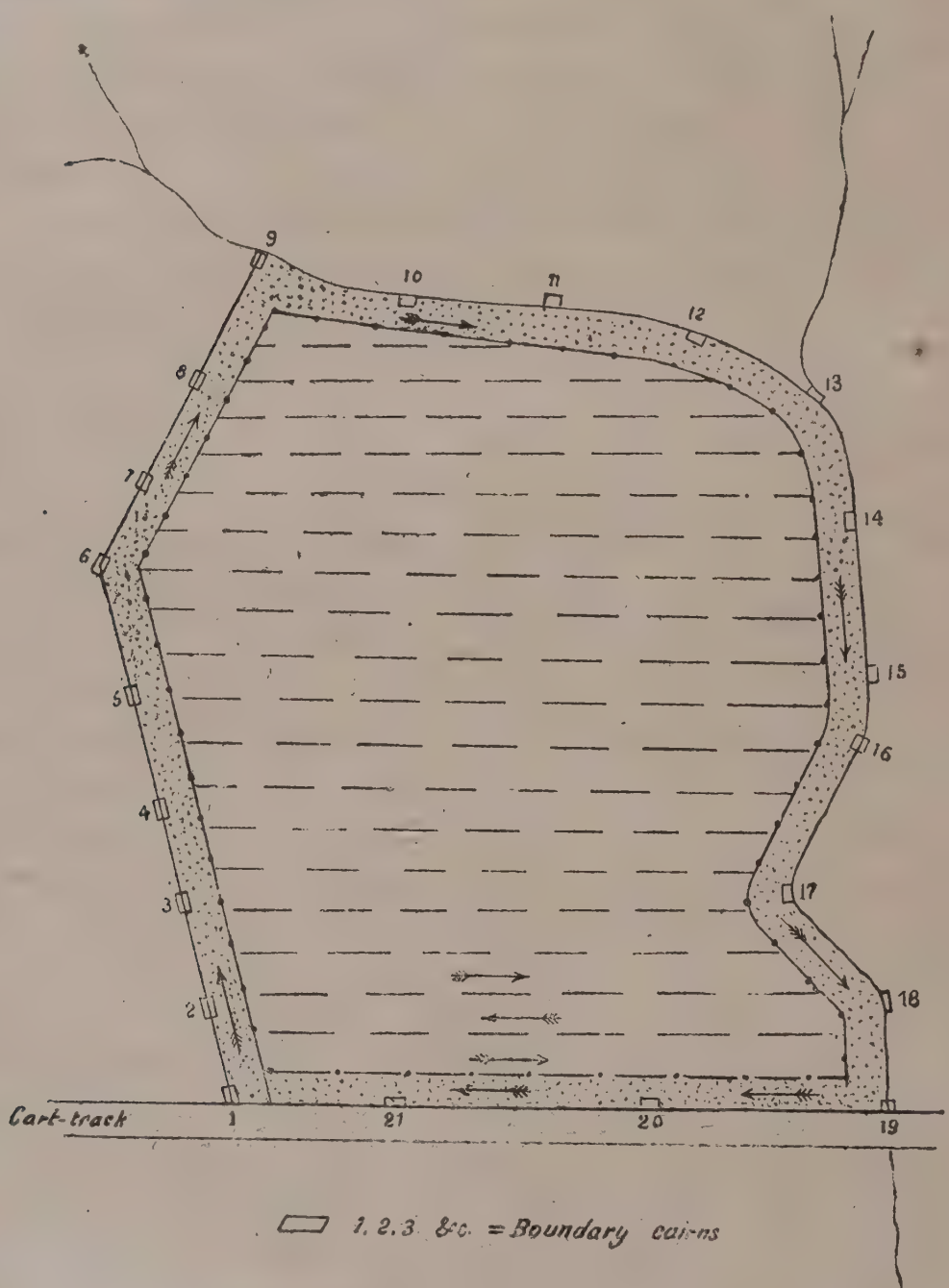
4. If the terrain of the coupe is very hilly, the area may be divided up into suitable blocks, and the strips in each taken more or less parallel to the contours.

5. As a safeguard against illicit felling of standards by contractors, special guards are detailed to supervise the work daily in the more valuable coupes, and the contractor is made to comply with the following procedure:—When a tree is felled, it may not be squared or removed until it has been checked by the special guard, and the butt-end and the stump have been impressed with his marking hammer as a token that the felled tree is not a reserved standard and is passed. Further, no material under 24″ in girth is allowed to be barked in the coupe. If the special beat guard connives at the felling of a standard, he and the contractor alone will be held responsible when the theft is discovered on finally checking the reserves.

6. Since the introduction of this system of reservation of standards in parallel strips, frauds have, on several occasions, been brought to light. It has had a markedly restraining influence on contractors who cast covetous eyes on valuable standards.

7. When the price of tin becomes lower, small serially numbered tin plates may be nailed to the standards instead of writing the numbers in tar on blazes. If such tin plates are nailed to the

standards, the nails should not be driven home, otherwise the tin plates are forced off over the heads of the nails, because of growth in thickness of the trees.



H. W. STARTE,

Divisional Forest Officer,

North Khandesh.

5th April 1919.

SOME KHEDDAH INCIDENTS.

Elephants are captured by two methods in Assam, either by chasing herds and noosing calves, called *mela shikar*, or by driving into stockades, called *kheddah shikar*.

The former method, though far less productive, is the favourite amongst Indians because it involves no initial expenditure beyond the purchase price of the Mahal, and also because anybody, who catches an elephant, gains a great reputation as a *phandi* (nooser). One is inclined to have visions of elephants dashing through the forest until some well-thrown lasso brings up a calf all standing, much like a roped steer in the wild and woolly West, but there is actually nothing romantic about *mela shikar* except the fact that it is commonly practised on moonlight nights. The rope used is so heavy and the noose or phand has to be so large, that it is impossible to catch a moving object, and the noose has to be dumped down on the back of an elephant's neck in the hope that it will curl up its trunk and allow the noose to be pulled tight. Elephants will, time after time, remove the phand with their trunks and this is especially the case with young tuskers, who are provokingly cunning. An effort is generally made to creep into a scattered and feeding herd and then to pick out some youngster for roping, but if the herd is scared and moves off, it is necessary to pursue until a calf gets behind and can be cut off. Such a calf will often quieten down and stay with the koonkies until roped. The *phandi* sits on the koonkie's neck in the mahout's seat, and behind him there is another man, whose duty it is to get unwonted pace out of the koonkie by prodding it at the root of the tail with the point of a dao, and who also helps in shortening the rope after an animal has been noosed. The noose is tied with a piece of cord to prevent it slipping up too tight, but this can only be done when the captured animal takes a breather after the first desperate struggle, and if it has managed meanwhile to get round a tree, death by strangulation commonly follows.

The Forest Department, however, had a serious objection to *mela shikar*, because it was found that the *phandis* used their spare time in shooting deer and selling the flesh, while the bolder

spirits even went after tuskers and rhino. It is obvious that there can be no efficient control over these men, who are provided with elephants and guns, and can wander where they like in their particular Mahals. Personally, I have known of four cases of *phandis* shooting tuskers. In one case the elephant travelled a long way before dying, and the *phandi* tracked up the beast only to find that a number of tea-garden coolies had found the carcase first, and were prepared to settle his claim to the tusks with their axes. This must have been very bitter, but he could get no satisfaction. Information was given in another case that a *phandi* was going to take a pair of tusks by night to the local Kayah's shop, so the D. F. O. spent the night hiding close by, but nothing happened. When he got back to his bungalow, however, early in the morning, he saw a pair of tusks lying in his verandah. The ruffian, who had brought them, turned up later with a smirking countenance and said he had found them in the forest, and wanted the usual 12½ per cent. reward for bringing them in. Both the remaining cases relate to one man, who spread the report that there was a very big tusker in the Mahal going about killing other male elephants. He brought in two pairs of tusks and was paid the reward for them, but his little game was spoilt by some one finding one of the carcases with a bullet in the head and giving the show away. There must, of course, be any number of cases which never come to light.

A dead rhino, in the same way, is more profitable to a *phandi* than many months of hunting elephants. The horn can be sold readily for a large sum, while the dried flesh and skin are also valuable. A man could get anything from Rs. 200 to Rs. 400 for the various parts of a rhino.

This sort of thing could not be tolerated in a Game Sanctuary or Reserve Forest, so the Local Government, at the Department's request, embarked upon a scheme for hunting the Province systematically by *kheddah shikar* alone. The Mahals are, however, being so thoroughly worked under this system that their exhaustion is within sight, and steps will have to be taken to preserve the breeding stock, or there will be no elephants left to hunt. It might be found feasible to allow *mela shikar* from time

to time in the Khas and some of the Reserves, while the Game Sanctuaries and remaining Reserves are specially kept for Government Kheddahs for the supply of the necessary big elephants.

An equally cogent reason for the suppression of general Kheddahs is that it is found that it has led to terrible cruelty being perpetrated upon the elephants in some of the Indian-owned Mahals. The trouble is that small elephants are more valuable, when first caught, than big females, unless these be of very particular build. A female or tusker calf about 6 ft. high will sell for Rs. 1,500, if possessing the correct number of white toe-nails (18) and a full tail, but a big female will only fetch about Rs. 1,200 or possibly Rs. 1,400. These figures refer only to untrained animals. The reason for this is not far to seek. There is a great demand for elephants, other than mucknas, in other parts of India, and the railways will carry animals that are not over about 6′ 6″, so that any trader, buying only small elephants, can rail them to his market expeditiously, instead of having to march them, while still soft, for several weeks along the Trunk Roads, with all the difficulty and expense of procuring adequate and suitable fodder. Again, it is obviously much easier to handle and train the youngsters, two of which can be controlled by one koonkie, whereas a larger elephant may require two koonkies to itself alone. Small elephants, too, do not put up such a fight, so that the danger of death from bad rope-galls is very considerably less. It may, therefore, pay a Mahaldar to scrap the big elephants, which he stockades, and remove his koonkies to deal with other catches as soon as possible. A Purneah trader will be managing and feeding all the small elephants, which he has purchased, without the help of a koonkie 10 days after an auction sale, but a bigger elephant requires the use of a koonkie for training, and especially for bringing in grass, for a longer period than this. The Mahaldar is bound to lend his koonkies to the purchasers of the wild elephants until they can go by themselves, so that anyone, who buys a big elephant, is very much in the hands of the Mahaldar and he is very much in the hands of his men. They are not particularly interested as to the fate of the animals, and the temptation is to adopt the most violent

methods of training, so that the elephants are finished with, one way or the other, as soon as possible, and the koonkies freed for other work. A common device with such men is to cut a slit across the back of the neck of any elephant, which shows much fight. The neck rope, or phand, is made to fit into this, and then the animal can only struggle at the risk of enduring most frightful pain. Septicaemia is the common form of death, arising from the rope-galls on neck and legs, and the large numbers of punctures from spear-thrusts. The elephant is very often slow to die and may not succumb for two or three months to the punishment it has undergone. There is no mercy, of course, for elephants that have just calved, or are about to calve; they have got to go through it just the same. Mahals differ, naturally, very much according to the Mahaldar, and these things do not go on under European supervision, but prevention is better than cure, and by only allowing *mela shikar* such abominations will be largely curtailed. Omelettes cannot be made without breaking eggs and a certain proportion of mortality is bound to occur even amongst the calves caught by *mela shikar*.

When the Kamrup Mahals with those in the Khasia Hills came up for sale for two seasons in the spring of 1917, the Forest Department retained for itself a compact block of Reserve Forests, because the area was known to be a regular elephant breeding ground, so that, by stopping operations here, overhunting elsewhere could be, to some extent, counter-balanced, and also because there were certain prescriptions of the Working Plan to be carried out, to which an outsider might object as interfering with the hunting.

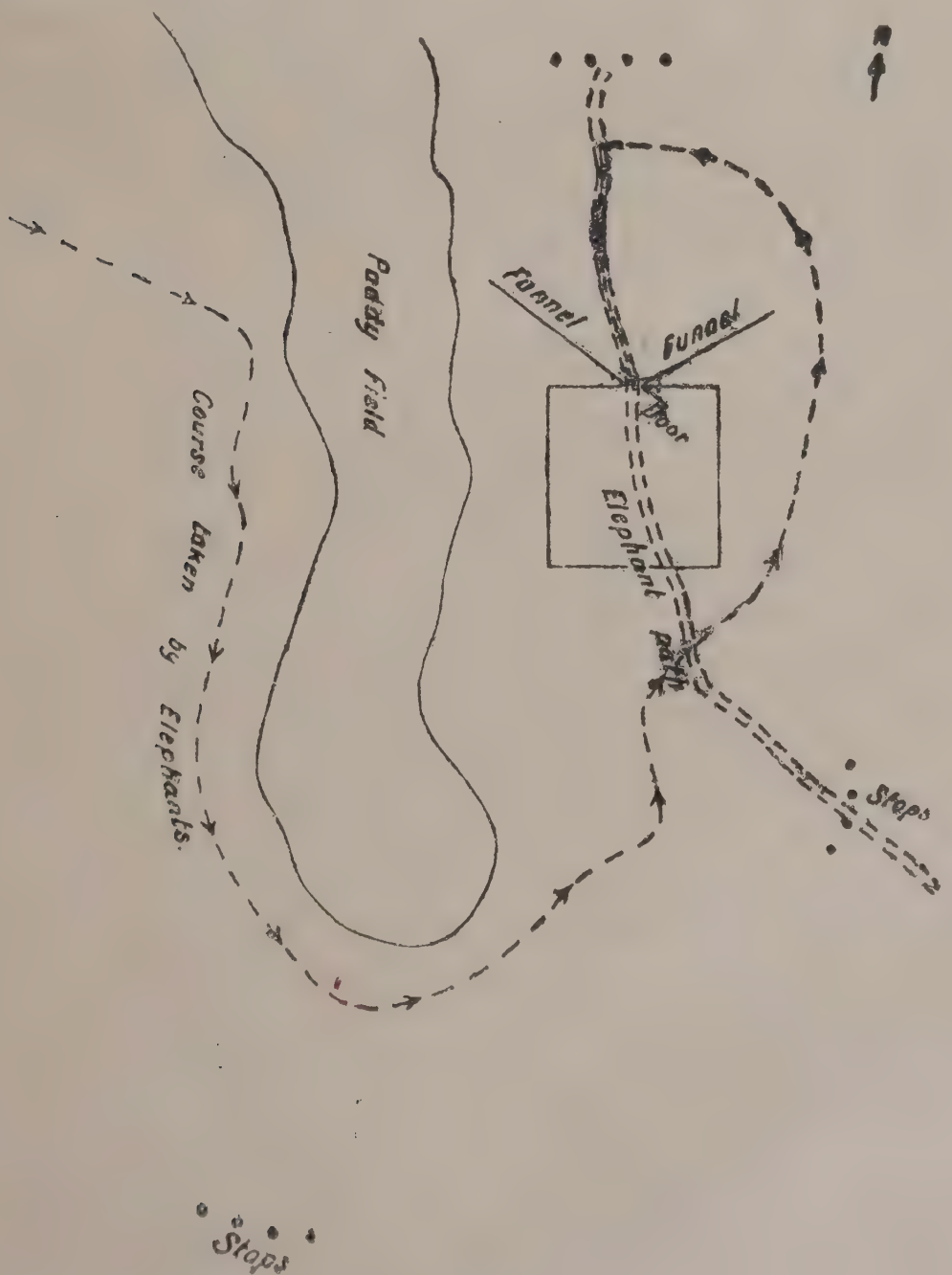
The Forest Department caught 40 elephants between December 21st and the middle of February, the next Mahal and the neighbouring Khasia Hills caught 78 between August and the end of March, while 49 elephants were taken in the third Kamrup Mahal and adjacent Khasia Hills. Quite a considerable number were caught elsewhere in the Khasia Hills too.

There still seemed to be a fair number of herds about, but to be on the safe side we determined to release all the dhuis (breeding females), which were caught in the Government Mahal

during 1918-19 and so not reduce the breeding stock more than we could help.

We commenced operations this season on November 29th, when an exceptionally large herd of 50 or 60 elephants were reported near the Borbakra Stockade. The drive failed on account of a new-born calf, whose mother kept charging back, and of a big tusker, which chased the drivers.

A rough diagram, not drawn to scale, will help to elucidate the following day's operations.



The stockade is built across an elephant path to the east of a long narrow finger-shaped stretch of paddy land.

I told the man, who as co-partner had to build and pay for this stockade, to put in two gates, but I found afterwards that he had only put one in, on the north. When I asked him why, he said he did not see how it would be possible to catch elephants if there were two gates, as the elephants would go in at one and out at the other. I explained to him that anyone less of a pudding head would have understood that the door farther from the herd would have to be closed before the driving commenced.

The Borbakra people were rather down in the mouth about this time owing to a number of deaths from influenza, so I told them all early in the morning on the 30th that this was a lucky day, because elsewhere in Assam the Peace Celebrations were being held. All sorts of forest guards and mahouts had to be called upon to help in the driving in order to make up the numbers necessary for the 'zubberdust' operation we contemplated, namely, bringing the herd across just beyond the south end of the paddy-field, then north past the stockade and back again south along the proper elephant path. If the paddy had been cut, the elephants would have been out at night to eat the straw, and driving would have been much simplified; also, obviously, if there had been a southern door to the stockade.

The drivers went off about 9 A.M. and I sat with the other door men on the edge of the paddy-field (called "pathar" in Assam), near the end of the funnel. The first we heard of the drive was the cracking of some bamboos just across the other side of the "pathar," and soon afterwards we heard the tap-tap of a dao on a tree. As little noise as possible is employed in driving elephants, provided they are going right, because they are inclined to panic and break away in different directions, if much frightened. Guns and shouting have to be employed when the herd is heading the wrong way and trying to get out of the drive, in the hope that it will turn back and proceed as desired. We got up into the 'machans' now, and it was not long before the excitement began. The elephants were extremely averse to crossing at

the end of the "pathar" and broke back a number of times. There were various parties acting as stops, and they had a busy time, as the big herd began to dissolve into its component parts or families, and the different bands sought to escape towards some favourite ground to the south-west. The stops managed to get in front of a herd of about 15, which were driven back by a gunshot and returned to the bamboos on the wrong side of the "pathar." The drivers got round behind them again, and the whole force of beaters was concentrated on this lot, which was absolutely compelled to take the course it objected to. There is a piece of ponky (marshy) land between the end of the "pathar" and the stockade with enough cane to discourage a human from trying to get through, and the first intimation we at the stockade had of the elephants was the sound of them coming through the ponk. There were stops on a hill to the south-east, but they had nothing to do, and the elephants turned northwards of their own accord. There are some bamboos growing near the south-east corner of the stockade, and it was quite exciting seeing these being bent to one side as the herd forced its way through.

Once clear of the bamboos the elephants came into sight. They were now not more than 30 yards from the gate machan, in which I was squatting, and being on the side of a steep hill the animals were, if anything, a little above our level, a truly impressive sight at such short range. We, of course, were lying very low, but it seemed ridiculous that they did not spot us. Something went wrong after the herd had got round the end of the funnel, and about eight broke away up the steep hill to the east, the remainder going straight on north. These had to be turned by the stops, and there was a most exciting pause between hearing the shouts of the stops die down and the arrival of the elephants at the stockade; the stops must have been about 400 yards away. Disaster was nearly occasioned by one of the amateur beaters, whose enthusiasm took him, though very far behind in the hunt, through the ponk and cane, so that he was passing the end of the stockade, uttering hoarse cries, just at the time that the elephants were coming along to enter it; however, some one

managed to scrag him before it was too late. A batch of drivers should have come across from the other side of the "pathar," but the information was not passed along properly, and no one came to press the elephants over their last lap. The consequence was that they straggled in: first came three calves and two dhuis in a great hurry. They entered without any demur and did not halt until the ditch and palisade at the other end of the stockade brought them up. They remained for some moments cogitating on these phenomena, and then turned slowly to reconnoitre the position. Nothing else being in sight, the door had to be shut as they approached it. It had just banged to, when a dhui and a calf arrived post-haste, and the man, whose duty it was to secure the gate, having bungled his job (luckily for us), the dhui barged it open and entered the stockade with her calf. One of the big dhuis inside had, at that moment, got a run on and, as the new arrivals scraped their way in round the end of the gate, she landed right in the centre of it, and banged it shut with a crash that must have afforded her the greatest satisfaction. The gate was now fastened, but quite a minute later a fine young tusker, about 6′ 6″, turned up, seeking an entry, which unfortunately we had to deny him. We sent a couple of koonkies with phands after him, but he got away in the gathering darkness. The catch consisted of one stand-out dhui, one old dhui and a dhui, which showed rope marks on her legs. Of the four calves two were tuskers and two mucknas. A big tusker rolled up when it was really beginning to get dark, and I had, with the greatest possible reluctance, I must confess, to take my rifle and go after him. It was too dark to see anything more than his huge bulk, and as he sauntered off of his own accord, it was unnecessary to fire at him. He did return during the night and was fired at from the stockade.

The koonkies had no difficulty next morning in dealing with the run-away, which we took over for Government, and the four calves. The two remaining dhuis were released, being driven out of the stockade in front of the koonkies. There were 50 or 60 people looking on at the tamasha, and I kept these back for a

few minutes in order to let the koonkies get on a little distance. When we did start after them, we found that the two released dhuis were very close to us in the thick jungle, uncertain, apparently, whether or not they ought to follow their bellowing calves. We waited a moment or two, just to make sure, and then started off again along the path. My bearer, who was next behind me, having ascertained that there was no danger, promptly turned round and shouted to my sweeper "Jemadar, ut, ut," whereupon a still small voice from the highest machan in the middle of the paddy protested that he had "uted" as high as he was able, and could "ut" no more. The multitude was much pleased at the joke. I should explain that the other servants consistently work on the feelings of the poor sweeper, who is no denizen of the jungle by choice. They told him that there were a lot of tigers at this place, and whenever a civet cat came round the camp at night, they always called it a "bagh," the occasional roaring of tigers in the distance lending some substance to their statements; at any rate, the sweeper never emerges to verify the "baghs." He retires to his tent at dusk with a lantern and a great heap of fire-wood, and, at his own request, with the cook's murghis for company. He is said not to sleep at all during the night, and I must say he responded very quickly to my warning when, some weeks later, I rolled out at 2 A.M. to find a tusker eating stubble 80 yards from my tent.

We marched the elephants that very morning to a pil-khana near Kulsi, a Range Head-quarters and the site of our principal Forest Inspection Bungalow. We were greeted there with the news that elephants had been heard at night in a direction favourable for driving to our Tiyamara stockade, so I took a few men, and went to the stockade to make sure that everything was all right. It was lucky we did go there, as we found that the gate post of the south door had got out of the straight and that the end of the gate was resting on the ground. We fixed this up, and then shut the gate in order to tighten up the natural spring which we use for closing the door after the elephants are in. This consists of a long piece of cane tied to the top of a

stout sapling, the top of which is bent over by hauling on the cane : the free end of the cane is tied to the gate, and if this has then to be forced open the sapling is bent down still further. A thin piece of cane leading to a machan keeps the gate open, and one cut with a dao severs it and allows the spring to come into action.

I was up before dawn next day and away to turn out the beaters, who do not like early hours in the cold weather. The men, who had been watching the herd at night, reported that it was quite close to the south door of the stockade, and contained about 30 animals. The Tiyamara stockade is built across an elephant path high up on the north face of a hill in a little cup, with a steep hill behind, and hills on each side, to the east and west, that might be called mildly precipitous. One would need one hand free, at least, if one was going to walk along their face. To the north the path leads steeply downhill. The herd had spent the night in the Bil to the south, and on the far side of the hill.

The beaters went off about 9 A.M., while we, who were to man the machans, went up to the stockade and got to work. First of all we had to close the north door securely, and then we had to cut green shrubs and thoroughly camouflage the stockade, the funnels and the entrance generally. This had all been done before, but the leaves had died and it was advisable to have a little green about the place. The gate itself and one gatepost had been tastefully hidden with a fat-leaved orchid, which is common here, and needed no further decoration, and the post on to which the door was to shut, was a living Sal tree. As we had not previously caught elephants in this stockade, there was quite a fair lot of jungle growing inside naturally, and we had nothing more to do than dig a few holes with our daos and stick in shrubs. The far gate took us some time as the builders had forgotten to camouflage it on the inside, and now that it was shut, it was very visible. However we had finished it and put the necessary finishing touches to the funnels and the approach by 11, and we then got up into the machans. My duty was to secure the

gate; they had forgotten to build a machan this side of the gate, but I had quite a comfy seat on the palisade leaning up against the Sal tree, and I rigged up a screen of branches, so that I would not be immediately visible to the elephants when they had reached the far gate and turned round to consider the situation. We had a long and weary wait, and it began to feel very chilly after the hill to the west had shut out the sun about 3 o'clock, but we were rewarded by hearing faint shouts soon after 5, and shortly afterwards Boom! went the muzzle-loader, stationed about 400 yards from the stockade entrance and fired after the herd has passed to ginger up the laggards. I must pause at this breathless moment to explain that at the ends of the funnels (the functions of which are obvious) are two machans, in which dependable men are stationed to prevent the elephants from working away from the mouth of the stockade and escaping round the ends of the funnels. It is important that these men should know when to make a noise and when to remain silent. Elephants came over the skyline a few minutes after the report of the gun, 7 of them, 2 being dhuis and 5 being calves and half-grown beasts. They were up on the side of the hill to the east of the proper path, and their course would have taken them round the end of the eastern funnel but for the stop in the machan tok-toking his bamboo instrument at the right moment precisely. If he had done it sooner there would have been time for the elephants to stop and alter their course still more up the hill, if he had waited longer it might have been too late, and the elephants might have barged on and escaped. The hill, down and along which the elephants were coming, was so steep, that the leading dhui was on a level with the machan, when the man made his demonstration, and she spotted him. She charged down and smashed up the supports to the machan (luckily it rested principally in the fork of a tree), but was afraid to continue her course and turned and came down towards the mouth of the stockade. I thought she was going to bring her companions in for certain, but she crossed the path at right angles and began to climb the hill to the west, following up the funnel on that side. Now was the time for the man there to make

his demonstration, but having seen what had happened on the other side of the stockade his bowels had turned to water and he never made a sound. The elephants solemnly climbed up, found the end of the funnel, forced their way through some bamboos growing there, and passed slowly along the west side of the stockade, only 15 or 20 yards away.

Meanwhile another batch of four elephants came along, also up the hill to the east. The funnel man turned these too, and they came at a great pace down the hill and into the stockade. The catch consisted of two dhuis and a tusker and a female calf, which was rather disappointing. It is fairly certain that the unlucky accident of the stop being spotted by the leading lot of elephants caused that part of the herd to break away to the west, instead of entering the stockade. Herd elephants panic very easily, and for that reason the funnel stops do not shout or make any great noise. They are usually provided with a bamboo clapper, which they use with caution. It not infrequently happens that the driven herd comes along far ahead of the beaters, and slightly off the proper course. The funnel man concerned then gives two or three faint tok-toks with the clappers and the elephants at once stop. The sound is unfamiliar to them, so they are frightened to go on in that direction, but at the same time they have heard nothing to make them believe a man is in front of them, and they just decide to make a little detour and avoid the vicinity of this curious noise, that might mean danger, though not loud or aggressive, like man : the detour, of course, lands them in the stockade.

The Tiyamara stockade could not be built as strongly as desirable on account of the underlying rock, and with so few animals inside there was plenty of room for the bigger dhui to charge freely and give us all the anxiety we wanted.

The son of one of the co-partners in this stockade had never seen a kheddah before, but he learnt a great deal about the subject in a very short space of time, as the big dhui's first charge was against the part of the palisade, where he had stationed himself, and she sent him flying off. Our koonkies were at hand and we thought that there might be enough time before darkness

to rope the two calves, so we called the *phandis* up to the south entrance and prepared to admit them. The south gate is well hung for shutting, but is a little troublesome to open. There was no rope fixed on to it for anyone to haul on to from the side of the stockade, so the leading koonkie had to shove it open by himself. He had got it about half open, when the dhui came full-tilt at it and shut it slap in his face, knocking him backwards a few yards, and we then decided to wait for daylight next morning and arrange to open the gate more expeditiously.

The old-fashioned stockade consisted of a number of stout uprights, well buried in the ground, with logs placed horizontally in between the uprights to make a solid wall, but this was an expensive form of construction, and it has been found that a much more lightly-built stockade can be made to suffice, if scientifically constructed.

Posts, 17 to 18 ft. long and 6 inches in diameter, are buried 5 ft. in the ground at intervals of 4 or 5 ft. Three rows of horizontal posts are tied to these on the outside, one row at the bottom, one in the middle and one near the top, and there are plentiful struts to support the middle and upper rows. The filling-in consists of green posts, about 3 inches in diameter, placed vertically with their bottom ends resting on the ground and not buried. These posts are tied with cane on to the three rows of horizontals, and as it is desirable that the elephants should be able to see through the stockade, the posts are placed not quite touching one another. There is a great deal of give in this form of wall, but it is difficult to smash. Men are stationed outside to poke at any charging elephant, with sharpened bamboos, while fires are lighted all round at night. A deep ditch is dug inside the stockade to prevent the elephants from being able to hurl their full weight against the wall, and they lose most of their momentum in having to pull up and stride across the ditch. It is found that elephants (at any rate herd elephants) will not charge with great conviction, if they can see a man standing, armed with a spear, on the ground outside, and for this reason it is a good thing to leave sufficient space between the upright poles. The door is obviously especially

liable to attack because it is unprotected by a ditch, and also because the elephants recognize that it is barring the very piece of ground, along which their path runs, but the elephants are kept off by the very simple expedient of tying small poles on to the door so close that the animals cannot see through it; they imagine that this must be the most solid and substantial part of the whole erection and do not go for it, as used to happen, before some wily person thought of this simple piece of camouflage.

I was just preparing to leave, when two of my servants arrived with considerably shaken nerves. They had heard that elephants had been caught and thinking that I might like some tea, they had started for the stockade, taking a short path along the face of the hill, which we had cut for ourselves in order to be able to approach the stockade without using the elephant track.

It appears that the seven elephants, which got away past the side of the stockade, hung about amongst the bamboos and rocks high up on the side of the hill until it was quite dusk, when they slid down, crossing our short cut a few moments before my servants came along, so that they very nearly met: as it was, they passed within a few feet of each other, and both got a good fright. These same seven elephants retraced their steps in the night, and passed quite close to the stockade despite the noise and the fires.

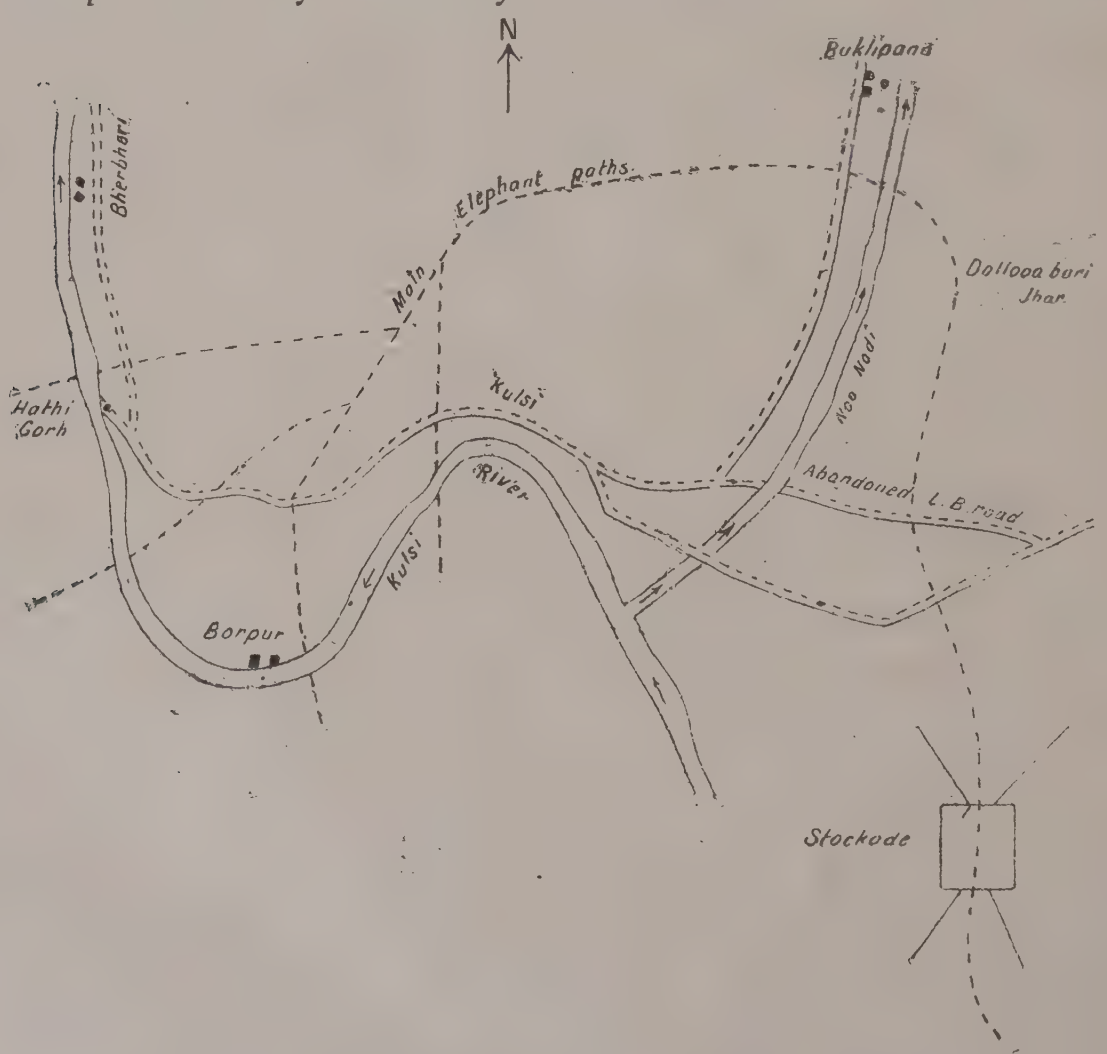
Orders were given for the koonkies to be ready early next morning and I started off about 7 o'clock myself. I had to pass our pilkhana on the way, and I was horrified to notice a most distinct swelling under the tail of the run-away elephant, which we had taken over from the Borbakra stockade. I called out all our elephant men, and we had a great headshaking and prophesying of a bad time. I must explain that this elephant had allowed herself to be prodded rather badly by a small tusker, caught at the same time as herself; we had experience of this sort of thing last year and feared that she had been injured badly and would require a lot of doctoring. We made up our minds to tie her up fore and aft in the evening and see what could be done.

There was no trouble with the elephants at the stockade. We roped the two calves and drove the two dhuis out of the south gate up the hill, down which they had come the day before. They

went away very slowly and majestically, stopping and turning round every now and then and bellowing, but I have no doubt that they legged it, as soon as they were over the crest of the hill and found that they were free and alone. It was a fine sight, seeing the great beasts stalking away so defiantly. We then returned in some depression to the pilkhana, having every anticipation of a month or two's doctoring a sick hathi morning and evening, a job we have unfortunately had to do too often in the past. I could hardly believe my eyes, then, when I discovered that the elephant had given birth to a calf during our two hours' absence at the stockade and the relief to us all was immense. It is an odd thing that an elephant shows very little outward sign, when carrying a calf, and we could see no difference in the size of the mother since she had given birth. This animal had quite a small calf at foot, when captured, and no one had suspected that she could be due to calve so soon again. Dhuis with biggish young ones at foot are certain to be heavy with calf, and so are immature females, whose teats are enlarged, but who have no calf running with them. The mother of the new arrival had been christened "Peace," as she was caught on November 30th, the day which Assam observed with festivity, and there did not seem to be any alternative but to name the youngster "Plenty." It had taxed one's command of the vernacular to explain exactly the appropriateness of the name Peace, but there was no corresponding difficulty about Plenty, which could be explained as the approaching time, when dhotis would be cheap and shop-keepers would give 16 annas for a one-rupee note instead of only 14, the millennium, in fact. I have forgotten to mention that during the last drive a man caught a very young calf, which had been abandoned by its mother. He brought it in after dark. I ordered it to be taken away and fed artificially. It lived a few days and then died of indigestion, as usually happens, and I have since blamed myself for not having put it up on the hill before we released the two dhuis, as it is just possible that they might have carried it off with them, though neither of them, we knew, owned it.

Our next bout of real excitement started on January 26th, when a herd was reported close by. We thought that it would

go in the direction of a stockade some miles to the south, if we blocked certain paths, and we were considerably astonished to learn that it had passed through the Tiyamara stockade very early on the 27th morning: both gates had been left open to let any wandering goonda through without affording him an excuse to break up the palisade. The D. C. was staying with me at the time and we both put in an artistic and busy morning camouflaging, while arrangements were being made for a drive. We thought that the herd might very well be driven back the way it had come as it had apparently passed through the stockade unalarmed. The alternative, that the animals had marked the stockade and vowed never to return that way again, also occurred to us. Having passed through the stockade, the herd would either have to follow the path round to Borpur village, as shown in the map, or return the way it had come, as cultivated land to the east, north and west prevented any break-away in those directions.



The D. C. and I got up into the machan at about 3-30 p.m., while the drivers went out to try and drive the elephants towards the stockade from Dallooabari Jhar, where they were feeding. We heard gunshots and shouting not long before dark, and were in great hopes that everything was going smoothly, but we then had to endure a long and very tedious vigil until some men came with torches at 1-30 A.M., and told us that they had been unable to make the herd cross the abandoned Local Board Road. The elephants had been brought up to this without much trouble thrice, but had refused to cross and had broken back each time. We were exceedingly glad to be able to get down and go home to bed, as sleep had not been easy at the stockade. The machan was too small for us to sit in, and we had had to sit on the palisade itself with every prospect of falling off, if we dozed. The D. C. had found a position, in which he could wedge himself safely but with only one foot at a time, and he had dozed until the foot in use had gone to sleep, and then woken up and changed to the other foot. I had two safe positions in one sitting on a spike and in the other leaning back on to a spike and I had had to ring the changes accordingly. We sent the men off, after they had lighted us most of the way home, to watch the road to Buklipara and prevent the elephants from crossing, but they were unsuccessful in this and the herd crossed the road very early in the morning, scraping past Buklipara village. There were only nine men and $2\frac{1}{2}$ miles of road to be guarded, and the elephants were obviously determined to get away, and they avoided the fires along the road by sneaking across close to the village, where normally elephants do not venture.

Our next move obviously was to prevent them from crossing the road running west from Kulsi to the Kulsi River at Hathigorh, in the hopes that finding themselves unable to escape in that direction they would of their own accord retrace their steps and try to get through the Tiyamara stockade again. The news was accordingly sent out that we wanted men to keep the road at night, and about 150 had been collected by dark. These were distributed along the Kulsi-Hathigorh road and also along the

path to Bherbheri village with instructions to light fires every 20 to 30 yards, and to make as much noise as they could all night long, a certain amount of liquor being supplied to loosen their tongues and keep everyone contented. Guns were placed at the danger spots, while those in authority patrolled the road and saw that the stoking was satisfactory. The chain of fires, some 3½ miles long, made a most weird spectacle and the effect was quite beautiful where the road passed through a closely planted Teak Plantation, the stems and over-arching canopy of which looked like the pillars and roof of some cathedral, as the light from the fires rose and fell. The elephants made their first attempt to cross the road soon after 8, but they were repelled without difficulty. The herd contained a big muckna and an out-size in tuskers, and we had realized by this time that we were dealing with a herd, which had been stockaded in the Khasia Hills, but which had escaped owing to the tusker flattening down the palisade, so we had every reason to expect trouble. It was quite likely that the herd would break through in the face of the fires and the shouting if we let them get close enough undisturbed, and for this reason we made as loud and as continuous a noise as we could. The most efficacious weapon of the night was my 12 bore, from which I fired nearly 50 rounds in the course of my patrolling, choosing for each shot, so far as was possible, a spot where some one had fallen asleep. The great disadvantage attached to the possession of the 12 bore was that its aid was invoked whenever danger threatened, and I had some prodigious runs to put in, firing from the hip as I ran, à la Hun, to encourage the defenders in their resistance. About 9 we sent a man to fetch our dinner, and a very jolly dinner it was, that we ate squatting in the road. There was, however, one small tragedy connected with it, in that despite the most careful instructions two bottles of Stout, my tipple, were brought, but no beer for the D. C., who cannot abide Stout. We had just finished dinner, when an alarm arose and I had to run at top speed to the threatened point, that time a bitter disagreement arose between the Stout and the other constituents of my dinner; that is, I suppose, the

penalty of getting older, for one can remember a time when meals and furious exercise agreed very well. The elephants made a number of attacks about 11 o'clock and then no more was heard of them, and the D. C. and I had started off to the stockade at 1-30, when we heard a great noise on the road behind us, and we had to hurry back. An elephant had crept silently up to the road and was very nearly on it when its presence was detected in the firelight, and it had nearly managed to slip through before a fire-brand or two drove it back. We abandoned any idea of going to the stockade after this episode, as the elephants clearly had no intention of obliging us by going back in that direction. This was the last alarm and the rest of the night was spent dozing round the fires: the night was luckily cold and one kept on waking up as soon as the fire burned low. Once soon after dark and again just at dawn tigers crossed the road, close to fires and not apparently much put out.

We decided to try a drive by *force majeure* next day, as the herd was too cunning for ordinary methods, so we sent out about 80 men, in place of the original 9, and 3 koonkies. These latter were not much use, as they refused to approach the wild elephants and kept behind the beaters the whole time, and there is no doubt that they knew all about the big tusker with the herd. The D. C. and I were at the stockade by 4 in the afternoon with every intention of making ourselves comfortable on the enlarged machans, which we had built, but Fate was against us, and a downpour, as unexpected as it was unseasonable, commenced at half past 4 and kept on all night. Some of the drivers came for us at 9-30, with the news that the drive had failed owing to the two big elephants. The muckna had done nothing but charge all day, while the tusker kept walking round the herd and preventing it from bolting. The herd was in tree forest when the men came up with it, and the drive commenced favourably, but having got into a bil the animals refused to be forced out of it and they had to be left there. The rain prevented us from keeping the road as we had done the night before, and we heard next morning that the herd had crossed the river near Borpur before

we had got back to the bungalow from the stockade. Every one was much disappointed except, probably, myself, for I was unable to see how I was to fulfill my rôle of destroying the big tusker, if the herd had entered the stockade after dark, and it was quite certain that he would have been through the stockade within 10 minutes, if not shot. Permission is always given to destroy large male elephants that are too big to tackle, and I have had to do it, but it is a horrible business. This particular tusker soon afterwards separated off from the herd and was able to spoil a drive for us at Borbakra. A herd came out to eat the paddy straw one night, and the men had sneaked up into the machans all ready for the drive, when his lordship arrived upon the scene. The herd bolted from him straight away and the men were unable to leave their machans while he was about. After feeding for a short time on the "pathar," he wandered into the forest and discovered one of the wings of the stockade, with which he played spillikins. Then he either heard or smelt the men, and he had a happy time trying to pull them out of the machans at the gate, while they dodged him by going aloft up the Sal trees, on to which the machans were built. Generally speaking, large males are not found with the herds, or, if there do happen to be one or two, they are only too glad to break away and with masculine selfishness avoid all the trouble, and it is quite unusual to be confronted with goondas, who, like these two, stuck to the herd despite all the harrying they got.

The more one sees of kheddahs the more one is impressed with the fact that fear of man blinds the wild elephants to even the most obvious trap, and that experience teaches them little. Last year we caught a run-away, while two dhuis, which we set free were caught only a fortnight later in another stockade. We have taken another old run-away this season, and have recaptured an elephant, which we caught last year and which ran away just before the New Year. It is improbable that an animal would allow itself to be caught twice in the same stockade, but there does not seem to be much difficulty in re-catching run-aways, and they do not seem to be capable of warning others effectually.

Our fears that there might be too many elephants caught this year are likely to prove unfounded : the man, who caught 78 last year has only taken 8 this season with 6 weeks to run, while the man who caught 49, has only captured 1. The Forest Department has 26 to its credit, out of which all the full and half-grown females with the exception of Peace have been released, 9 in all. It might be supposed from these figures that there was indeed a shortage of elephants in the forests, but this is not the case. My neighbour, who caught the 78, has solely himself to blame this year, as he has quarrelled with his hunters and they have left him for the very good reason that he refused to give them any rice to live on, and so it is in the other Mahals. It would be an eye-opener to Mr. Montagu, if he could spend a month in an elephant mahal, and realize how absolutely impossible it is for these sort of people to pull together as a team, even for their own mutual benefit. One mahaldar last year refused to disgorge any of the money he had received, so his men went to his house with daos and demanded their agreed-upon share or else his blood. He came out with a gun and said he would shoot them, but they did not mind, because, as they pointed out, he would not have time to shoot them all, so he had to cave in and pay up. This sort of behaviour does not inspire confidence, but is good for the hathis, because if the mahaldars and their employees did not squabble and cheat each other, and if they were to have a brain wave and spot the two first golden rules of elephant-catching, very few elephants would escape. Wild horses would not drag from me what the first two rules are. A large number of elephants have had the sense to seek refuge in a part of our forests where they are not usually found except casually, and consequently they are safe so long as they remain there, because it is too late now for anyone to start building stockades. One of my most experienced men saw a collection of elephants in that direction, which he reckoned contained 100 animals, and he is not likely to be more than 20 out in his calculation, as these people are really accurate in their estimates of the numbers composing herds. Long may they stay in safety is our pious wish. The actual driving is an art, or should be. m The Khapties from Upper Assam are our most

skilful exponents, as they work in teams and pull together. The Kulsi men, that is to say the picked men, are every bit as brave, needlessly brave to the point of stupidity, but they are undisciplined and need a leader. They know every inch of the country but their drives go wrong because they do not understand that the plan of campaign must be first worked out at home, and, as I have said, they have not grasped the first two simple golden rules. The work affords them much pleasurable exercise to which is attached the hope of gain, so we let them be, as our object is not to catch so very many elephants. The principal obstacle to Europeans joining in the driving as at present managed is the difficulty of being nippy in boggy ground under the tall grass, but in an artistic drive, properly planned, there would be little danger to anyone accustomed to get through jungle at a reasonable pace. The stops are the most important people in the operations, and the stupidity and negligence of which they are capable, need to be seen to be realized. There can be no question but that catching elephants is a most exciting and pleasing occupation for anyone, who is interested in these sort of things and who is prepared to forego regular meals and a comfortable bed, but like nearly every other occupation it has its drawbacks, the chief of which is the difficulty and anxiety experienced in looking after the elephants, which have been taken. The most assiduous personal attention is necessary, if the mortality percentage is to be kept down, because none of the *phandis* and other men in the pilkhana have any particular interest of the fate of the captives, and an extra bunt or two from a large koonkie may inflict fatal injuries. Bringing in large quantities of fodder is wearisome work for all and likely to be scamped, which means that the new elephants get starved and weakened. It is said that the most prominent object in the old Government pilkhanas was the Triangle, and no large establishment of elephant men could be run properly, if punishment suitable to the class of men could not be inflicted.

The most ineradicable fault that the men have is their fondness for spearing the wild elephants on all possible occasions. If an elephant will not put its foot into the prepared noose, the

foot is speared; if the animal does anything wrong with its trunk it is speared and so on, until the poor beast is a mass of punctures and galls from the ropes. Last year I tried quite different tactics with a young female, which we took over to train, and as I was the medicine man myself, anyone who gave me more work to do by adding to the number of wounds was promptly "adjusted" in the most suitable manner. The result has been a most triumphant success. The animal has been perfectly trained, is absolutely obedient and goes this season into the stockades as bold as brass. Two young tuskers, bigger than she, who were caught at the same time, are still very kutcha in their training, and are scared to death in the stockades, where they ought to show more pluck than a small female. Presently no doubt they will become good koonkies, but meanwhile all the pluck they showed, when first caught, has been hammered and speared out of them by bad treatment. A wild elephant is necessarily a handful to manage, especially as it has every intention to kill any human being who comes within reach, but there can be no doubt that it can be much more effectively trained, if not scared out of its wits by brutal treatment and it will very soon tolerate men if kindly handled. A good beating with a stick soon shows it that there is only one safe place to keep its trunk, while it will abandon kicking if the stick is similarly applied to its feet. A tusker, which we are now taking in hand, is proving most amenable to our rational method of treatment, and is settling down to his training sensibly and quietly.

Large elephants are naturally more dangerous to tackle than small ones, and require stern measures occasionally; but as it is impossible to make men sensible or humane by law, it will be a good day for the elephant, when only small ones may be caught, and at the same time closing the kheddahs will prevent the further depletion of our decreasing stock. Complaints are frequently made of the havoc caused to crops by elephants, but the damage is almost entirely caused by solitary males, and measures for dealing with them are being considered. Those interested in elephant hunting are prone to try and make out

that hunting is the cure for this destruction of crops, but such a contention is easily refutable by examining the footprints in the paddy fields, and by asking the villagers. A case came to light last year where 18 out of 38 elephants, mostly breeding females, were killed in training by the mahaldar. The value of these beasts could not have been less then Rs. 20,000, a serious ecomonic loss from every point of view, while every animal of the 18 was done to death, through ignorance and callousness, in the most hatefully cruel way. Too much of this cruelty and waste is associated with kheddahs, even when run by Indians of experience, to permit of the system being carried on, and its exposure will put an end to a great deal of suffering.

A. J. W. MILROY, I.F.S.,

Assam.

WALNUT EXPLOITATION IN HAZARA, N.-W. F. P

Early in August 1917, enquiries were made by the Forest Economist at Dehra Dun to find out if the walnut requirements of the Ishapore Rifle Factory for rifle butts, etc., could be supplied from Indian forests. As a result, in September 1917, a conference of all the parties concerned was held at Dehra Dun, and it was decided that the Hazara forests should endeavour to supply, annually, ten thousand sets of steam-seasoned walnut ½ wroughts, *i.e.*, an equivalent of about 3,300 c. ft of manufactured timber.

Immediately after this, fellings were started in Reserve Manshi B, in the Kagan valley, and a start was made with the erection of workshops and steaming plant at Jaba, 38 miles from Havelian, N.-W. R., by cart-road, of which some 6 miles is rough and 32 miles good cart-road. The site selected is in reserved forest land, thus avoiding land acquisition proceedings. By the end of December 1918, all the buildings and plant at Jaba had been erected and a first supply of steam-seasoned walnut ½ wroughts had been made to the Rifle Factory at Ishapore. A brief account of the various operations involved in the manufacture and

steam-seasoning of these ½ wroughts may be of some interest to readers of the *Indian Forester*.

These operations fall under two heads :—

(*a*) In the Forest.

(*b*) At the Workshops.

(*a*) *In the Forest.*

In the Kagan Range of the Hazara Division, walnut is found growing gregariously in large patches as well as scattered in groups and single trees in Deodar, pine and fir forest on comparatively easy ground, at elevations varying from 6,500—8,500 feet above sea-level. There is practically no natural regeneration as the walnuts are destroyed in large numbers by vermin, while many are collected by man for food. Generally speaking, the trees are branchy, the first branch appearing at not more than 25 feet from ground-level. Trees above 8 feet in girth at breast-height are mostly hollow at the base.

Fellings were based on the system of clear felling, all trees of 6 feet girth and above at breast-height being felled in the area selected for felling. 200 of such trees were felled in November 1917, at a cost of annas 7 per tree. It is important to carry out the fellings in autumn when the sap is down, with a view to reduce splitting in the wood before it reaches the workshops.

Logging is done with the saw and is, as far as possible, completed before the first snowfall, which renders further working in the forest impossible. All large knots, especially where they occur on opposite sides of the boles at the same level, are entirely excluded and this necessitates cutting logs to lengths varying from 3½ feet to 9 feet in length. The cost incurred is annas 4 per log.

Sawing is done at a cost of about annas 4 per c. ft. (including "godown" expenses) by sawyers mostly imported from Kashmir for the purpose. Only "slabs" were sawn 3 inches thick and between 4 and 12 inches in width. The sapwood was in the first year excluded as far as possible, but this is not essential as the Rifle Factory also accepts sapwood. The average outturn comes to 35 c. ft. of "slabs" per tree.

Carriage.—This part of the work gave most trouble and was a long drawn out operation, the last planks not being delivered at the factory before 15th March 1919, *i.e.*, a period of 10 months since May 1918 when sawing was started. The carriage down to the main Kagan valley road, a distance of seven miles, was done by coolies, and then by mules, bullocks and donkeys along 29 miles of the road up to Jaba Workshops. The carriage was paid per maund, the cost being Re. 1-8 per maund or an average of about annas 14 per c. ft. This is the heaviest item of expenditure.

Precautions taken to prevent splitting before the timbers reached the factory were :—

(*i*) The ends of planks were smeared with cow-dung.

(*ii*) The planks were kept in the forest and at all the immediate depôts in stacks and under cover.

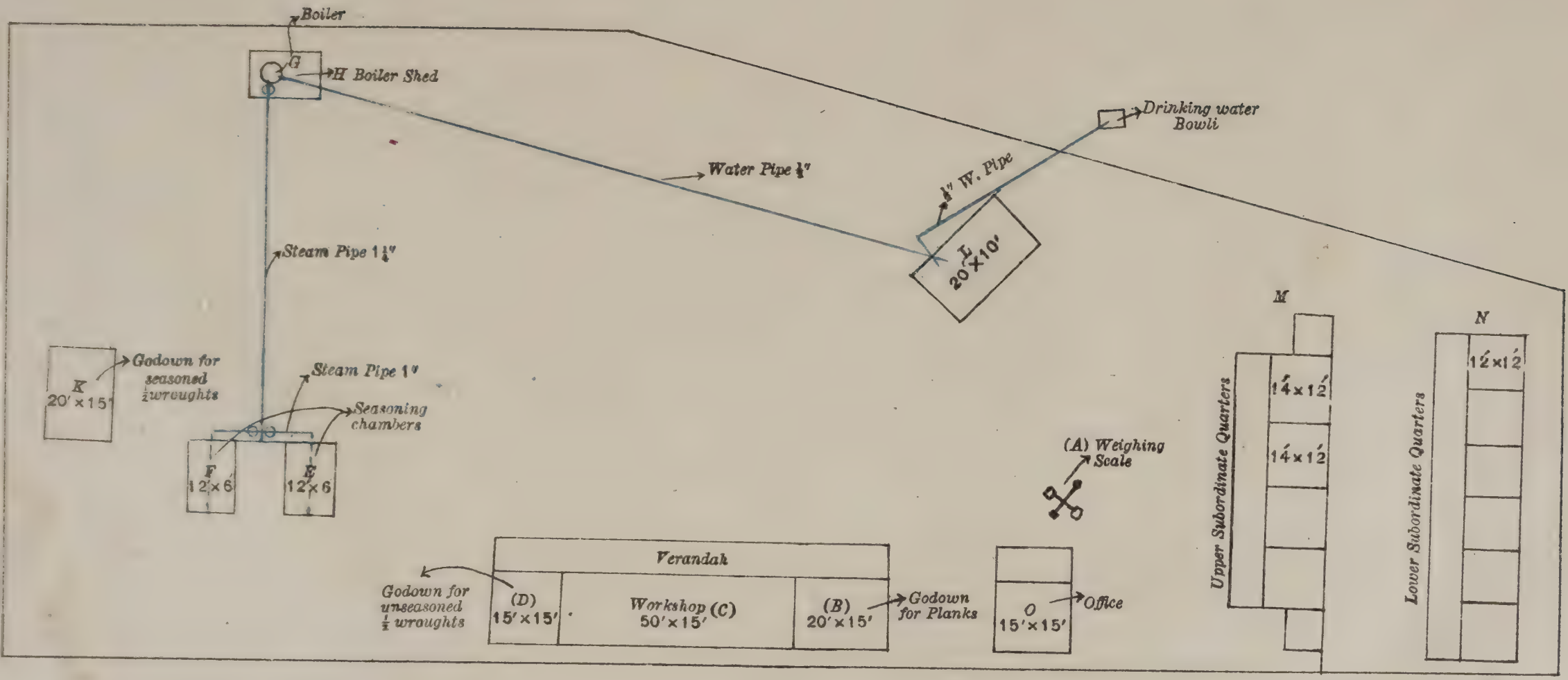
(*b*) *At the Workshops.*

(*i*) Making of ½ Wroughts—

A site plan of the workshops is given in plate 21. On arrival at the factory and after being weighed on the scale, marked A on the plan, the planks are stored in godown B. Thence they are taken into Workshop C where the outlines of the ½ wroughts are marked on them by means of templates supplied by the Rifle Factory, Ishapore. Plate 22 gives the dimensioned drawing of these, there being four to a complete set, (*viz.*, Butt, Fore-end, Front and Rear Hand guards). The greatest care is required in tracing as the ½ wroughts have not only to be absolutely straight-grained but also free of all kinds of knots, shakes and inlocks and defeats of any kind. This selection of the best wood involves a good deal of wastage which amounts to as much as 60 per cent. of sawn planks. The long lines traced on the planks are then cut with frame-saws by sawyers, these sawn planks being afterwards made over to carpenters, who finally reduce the ½ wroughts to prescribed dimensions and who also plane all the four sides of each piece. At the end of the day's work these ½ wroughts are passed by the Head Carpenter and then transferred to the godown for unseasoned ½ wroughts, marked D in the plan, where they are kept until required for seasoning.

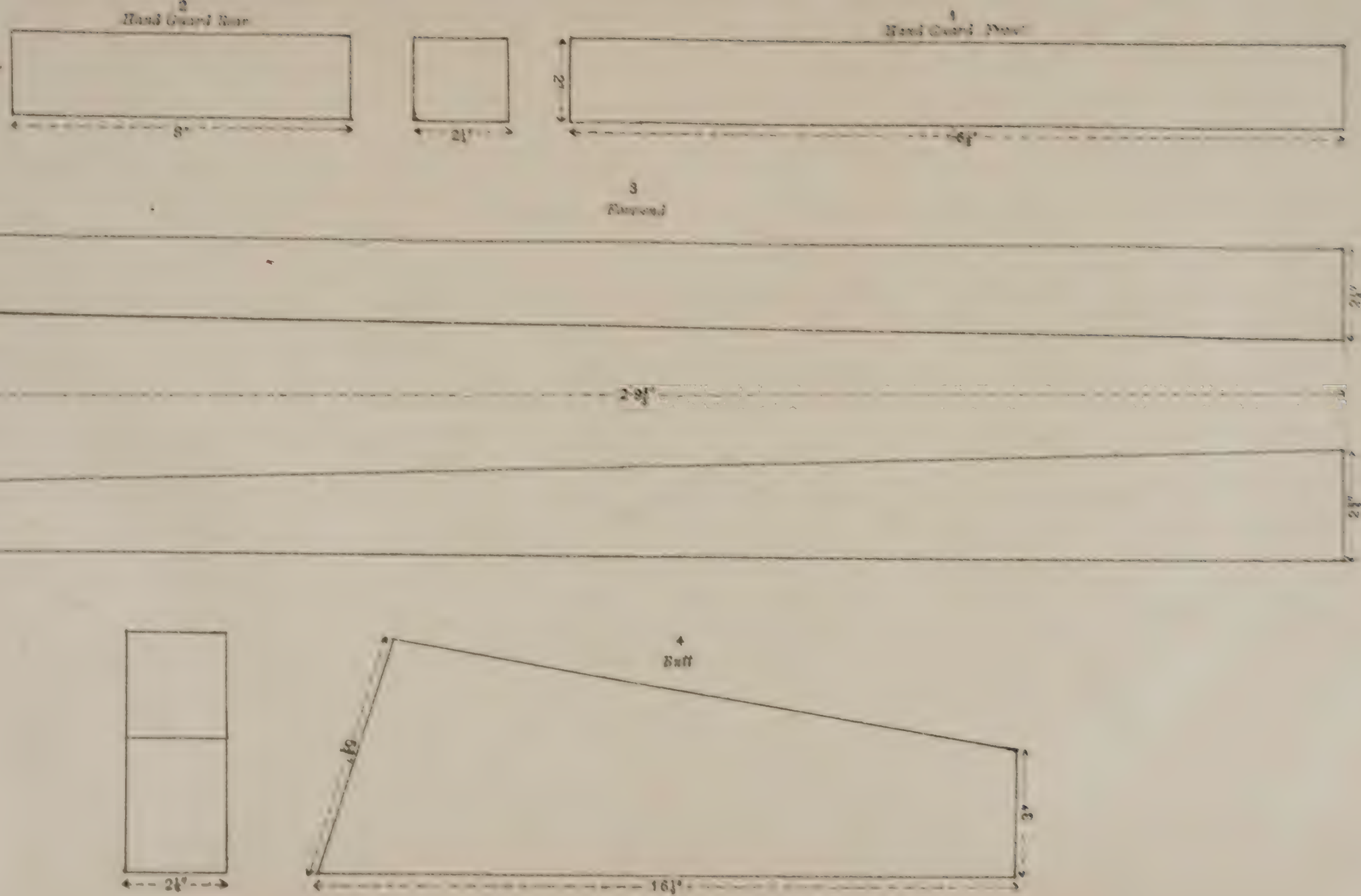
SITE PLAN
OF
JABA WALNUT FACTORY.

Scale—1 Inch = 40 Feet.



HALF WROUGHTS

Scale—3 Inches = 1 Foot.



The cost of making the ½ wroughts comes to roughly annas 6 a set. As will be seen from the above, a good deal of manual labour is resorted to. To eliminate this, it may ultimately prove desirable to set up a band-saw to be worked by an oil-engine with a view to speeding up work and reducing working expenses but a decision on this point will be postponed until further experience has been attained.

(*ii*) Steam-seasoning—

The objects of steam-seasoning are threefold :—

Firstly.—It seasons the wood in a shorter time than in the case of natural seasoning.

2ndly.—It gives a uniformly pinkish dark brown colour to the wood which is originally of a greyish colour. The originally white sapwood also assumes this colour.

3rdly.—Dry rot, etc., is greatly reduced by the destruction of fungus spores and mycelium.

Process of seasoning.—The ½ wroughts to be seasoned are stacked in layers in two masonry seasoning chambers (marked E and F in the plan) built into the hill-side, with 1 thick Deodar "lays" in between to admit of the steam being in contact with all sides of each ½ wrought. These stacks are wedged at the top against rails provided for the purpose to prevent warping during seasoning. Iron doors are then fitted against the opening in the front, and this renders the chambers absolutely air-tight save for two pipes at the bottom of the face of each chamber, which serve as outlets for condensed water. The steam is supplied to these chambers by means of pipes from a 3 N. H. P. vertical boiler (G in the plan) erected in the boiler shed (H in the plan). The pressure is never allowed to exceed 10 lbs. per square inch. The steam is supplied continuously day and night without a break for a period of from 3—4 weeks. It, however, appears that the period allowed is too long and experiments are now being started to find out if it is possible to shorten this period consistently with the attainment of the object aimed at. On the completion of the steaming period, the ½ wroughts are left in the chambers until

they cool down to within 10 degrees (Fahrenheit) of the temperature of the surrounding atmosphere.

The ½ wroughts are then removed to the godown (K in the plan) where they are again stacked with "lays" in between to dry, since the wood is saturated with water at the end of the steaming process. Experience has shown that as far as these seasoned ½ wroughts are concerned all sudden changes of temperature have to be studiously avoided, as otherwise they develop "shakes" which render them unsuitable for the purpose for which they are required.

After the ½ wroughts have got rid of all the absorbed water the ends of each piece are sealed with rosin diluted in kerosene oil, the sealed ½ wroughts are tied into bundles with ropes and are then ready for despatch to the Rifle Factory.

Water-supply.—For the purpose an excavated 5,000 gallons capacity masonry tank (L in the plan) has been built ; the water is led into this from a spring tank, about a furlong higher up by means of a wooden water channel made of hollowed out Chil poles. From this tank the water is fed into the boiler by means of a ½" water-pipe. This tank is situated about 40 feet in vertical height above the water inlet of the boiler and consequently the water is fed into the boiler entirely by gravity.

In addition to the buildings alluded to above suitable quarters have been built, both for the upper and lower subordinates (M and N in the plan). A small office room (O in the plan) is also attached.

Cost.—The buildings, boiler, fittings, tools, etc., involved a total capital expenditure of Rs. 20,850. The cost per set including depreciation, interest on capital and a royalty of Rs. 2-8 per c.ft. of planks sawn in the forest comes to Rs. 5 *f.o.r.* nearest Railway station at present, but with more experience and improvements in methods it is quite possible that the cost will be materially reduced.

KHAN MUHAMMAD KHAN,
Extra-Assistant Conservator of Forests.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester*.

FROM THE FRYING-PAN INTO THE FIRE.

SIR,

A few years ago I witnessed an incident so strange that, if my wife had not been with me at the time, nobody would have believed my yarn. Fortunately she has a great reputation for veracity, and, thanks to this, nobody has, so far as I know, questioned the truth of the story. I have indeed more than once heard it repeated with many embellishments by people who did not know that I was the originator of it; but what actually happened was this:

Whilst walking near the bungalow one evening, we saw a monkey (a big langur) sitting on a log near the path. His back was towards us. I said to my wife "Watch me scare that chap," and made a sound as like a panther's roar as I could. The monkey swore at once, looked round, and ran up the nearest tree, *straight into the jaws of a real panther sitting in a fork fifteen feet up*. The panther caught the monkey by the throat, jumped with it to the ground, and made off into the jungle, leaving the dead monkey at the foot of the tree.

I shot the panther over his kill later on, and on our way home we heard his mate calling for him. The calling went on throughout that night and the next, but on the third evening I saw the widow accompanied by a new bridegroom, so her period of mourning was not a long one.

A. G. EDIE, I.F.S.

EXTRACTS.

LIST OF FOREST OFFICERS WHOSE NAMES HAVE BEEN BROUGHT TO THE NOTICE OF THE GOVERNMENT OF INDIA FOR VALUABLE SERVICES RENDERED IN INDIA IN CONNECTION WITH THE WAR UP TO THE 31ST DECEMBER 1918.

Issued with the Gazette of India, Extraordinary, July 29th, 1919.

Mr. H. R. Blandford, Deputy Conservator of Forests, Tharrawaddy Division, Burma.

Mr. G. S. Butterworth, Deputy Conservator, Forest Department, Bombay.

Mr. F. F. R. Channer, O.B.E., Deputy Conservator of Forests, Dehra Dun, U. P.

Mr. P. H. Clutterbuck, C.I.E., Chief Conservator of Forests, U. P.

Mr. W. E. Copleston, Conservator of Forests, Southern Circle, Bombay.

Mr. B. O. Coventry, Conservator of Forests, Kashmir and Jammu.

Mr. L. C. Davis, Deputy Conservator of Forests, Burma.

Mr. A. J. Gibson, Deputy Conservator of Forests, Punjab.

Mr. H. M. Glover, Deputy Conservator of Forests, Punjab.

Mr. N. V. Holberton, Deputy Conservator of Forests, Burma.

Mr. R. W. Inder, Bombay Forest Department.

Mrs. Lodge, wife of Mr. F. A. Lodge, C.I.E., Inspector-General of Forests, Hyderabad, Deccan.

Miss Lodge, daughter of Mr. F. A. Lodge, C.I.E., Inspector-General of Forests, Hyderabad, Deccan.

Mr. G. E. Marjoribanks, Divisional Forest Officer, Kanara Bombay.

Mr. R. G. Marriott, Deputy Conservator of Forests, U. P.

Mr. W. Mayes, Conservator of Forests, Western Circle, Punjab.

Mr. R. McIntosh, Conservator of Forests, Eastern Circle, Punjab.

Mr. A. W. Moodie, O.B.E, Deputy Conservator of Forests, Katha Division, Mandalay, Burma.

Chaudhuri Muhammad Aziz, Forest Ranger, Punjab.

Nazir Abbas, Extra Assistant Conservator of Forests, Nimar, C. P.

Mr. H. L. Newman, Deputy Conservator of Forests. Bombay.

Mr. J. N. Oliphant, M.B.E., Deputy Conservator of Forests, U. P.

Mr. R. Parnell, Deputy Conservator of Forests, Hazara Division, N.-W. F. P.

Mr. R. S. Pearson, F.L.S., Forest Economist, Imperial Forest Research Institute, Dehra Dun.

Mr. A. Rodger, O.B.E., Deputy Conservator of Forests, Rangoon.

Pandit Sunder Lal Pathak, Conservator of Forests, Gwalior State, Central India.

Rai Bahadur Shyam Sunder Lal, Conservator of Forests, Indore State, Central India.

Mr. H. Tireman, Deputy Conservator of Forests, Coorg.

Mr. R. S. Troup, Indian Munitions Board, Government of India.

Mrs. Waller-Senior, M.B E., wife of Mr. Waller-Senior, late Forest Department, Mysore.

Miss Waller-Senior, daughter of Mr. Waller-Senior, late Forest Department, Mysore.

Mr. H. L. P. Walsh, Deputy Conervator of Forests, Mu Division, Burma.

Mr. H. W. A. Watson, Deputy Conservator of Forests, Zigôn Division, Burma.

Mr. R. M. Williamson, Indian Munitions Board, Government of India.

Mr. H. L. Wright, Deputy Conservator of Forests, Kangra Division.

J. H. Lace, C.I.E., F.L.S.—A frequent visitor to the New Herbarium, and one held in very high regard by members of the staff there, passed away in June last at his home at Exmouth, Devonshire. John Henry Lace was trained for the Indian Forest Department at the National Forest School at Nancy, France, and passed out in 1881. On arrival in India he was appointed to the Punjab, and soon made a name for himself as a keen forest officer and accurate botanist. During his service of over thirty years he served not only in the Punjab, but in British Baluchistan, Bengal and Burma. While in Baluchistan he made an extensive collection of plants which resulted in the publication of "A Sketch of the Vegetation of British Baluchistan" by himself and Mr. Hemsley in Journ. Linn. Soc., xxviii (1891), p. 288. At one time he was Assistant Inspector-General of Forests, at another he was for a short while Principal of the Forest College at Dehra Dun, and again he once officiated as Inspector-General of Forests. His last appointment was that of Chief Conservator of Forests in Burma, which he held for about five years, doing excellent work not only in forest management but in the study of the flora of some of the less-known regions such as the Shan States and the hills around Maymyo. His useful and accurate "List of Trees, Shrubs and Climbers of Burma" is the present standard work on the subject and the beautifully prepared specimens collected by him are of the greatest value to Indian botanists. He presented a nearly complete set of his collections to the Kew Herbarium, and we are glad to hear that his own set has now become the property of the Herbarium of the Royal Botanic Garden at Edinburgh. Many new species found by him in the Burma forests have been described in the Kew "Decades" from time to time, chiefly by himself. His death at the age of over sixty years was rather sudden, and came as a shock to his many friends at home.

[G. S. G. in *Kew Bulletin*.]

GRASSES IN ASSAM SUITABLE FOR THE MANUFACTURE OF PAPER PULP.

A good deal of attention has been paid during recent years to the question of the utilization of bamboos for the manufacture of paper pulp, and two publications have already been issued by the Forest Research Institute on the subject. From time to time enquiries have also been made by interested parties as to the possibility of utilizing the elephant grasses for the same purpose, and a publication dealing with the chemical side of the question has been published by Mr. Raitt, entitled "Report on the Investigation of Savannah Grasses as Material for Production of Paper Pulp" [*The Indian Forest Records*, Vol. V, Part III]. Such enquiries cannot be considered complete without a consideration of the closely associated questions of total available outturn, yield peracre, cost of extraction to a possible factory site, local conditions, lines of communication, labour, etc., concerning which up to date nothing has been published. This subject has, however, not been entirely overlooked, and in 1916 and again in 1917, a careful inspection was made of the grass areas on the Monas river in Assam, with a view of collecting data on the above points.

An extensive grass area was found to exist in the angle made by the Brahmaputra and Monas rivers, on the east bank of the former opposite Goalpara, comprising the villages of Loti bari, Amguri, Pidardhara and Nayashastra, in the Barpeta sub-division of the Kamrup Division. The grass in this area is estimated to cover some 15,800 acres, while a similar area exists on the south bank of the Brahmaputra below Goalpara.

The most important species of grass found in these areas are Khagra (*Saccharum spontaneum*) and Batta (*Saccharum narenga*) with patches of Nal (*Phragmites karka*) on the more swampy ground. Sample plots were taken to determine the outturn per acre, in order to obtain an approximate estimate of the annual yield. The grass was cut over a given area and weighed green and again when dry, from which it was ascertained that Khagra yielded 7·8, Batta 3·5 and Nal 8·04 tons per acre of dry grass. It would not be possible to crop the same areas annually, and Mr. Hole, the Forest Botanist, who has for years studied these grasses

to determine their mode of growth, states that Khagra and Nal can be cropped every other year and Batta every third year. By adopting this rotation we get in round figures a sustained annual yield of 4 tons for Khagra and Nal and 1 ton for Batta. Khagra is found over a greater extent of the area than the other two species, so that were an average to be struck, based on actual areas covered by these three species, this average would probably work out to over 3 tons per acre ; for safety's sake it is assumed that all three species occur in equal quantities, and under such an assumption we may expect to get a sustained yield of 3 tons per acre per annum or a gross annual yield of 47,400 tons per acre of dry grass, which, put at a low yield of. 33 per cent. of pulp, gives over 10,000 tons of pulp per annum.

The cost of extracting a ton of air-dried grass to a possible factory site at Jogigopa, a small tahsil town in the Bijni Estate, just below the junction of the Monas and Brahmaputra rivers, worked out as follows :—

Khagra (*Saccharum spontaneum*), per ton Rs. 7-8-0.

Batta (*Saccharum narenga*), per ton Rs. 6-2-0.

Nal (*Phragmites karka*), per ton Rs. 8-8-0.

Hand samples of the above grasses were sent to England to be tested on a laboratory scale, while several tons were sent to an Indian paper mill to be made into paper. The results were satisfactory and proved that a very fair quality of paper can be produced from these grasses at a relatively low price. Small samples of such paper can be obtained by persons interested in these grasses from the Forest Economist, Forest Research Institute, Dehra Dun, who can also supply further details regarding the above described area.

It may be remarked that the Monas area was dealt with first by reason of its relative proximity to markets and sources of labour, and it may be superfluous to add that there are other very extensive and doubtless suitable areas in the Brahmaputra Valley and throughout Burma which have not yet been examined.

Dr. W. H. Brown, Ph.D., of the Bureau of Forestry, Philippines, has recently published a pamphlet on " Philippine Forest Products as sources of Paper Pulp," in which he deals with Khagra

(*Saccharum spontaneum*) grass. He states that Mr. Richmond found that the pulp bleached to a good white colour with only 2·3 per cent. loss in weight, by the use of 5·7 per cent. of bleaching powder, calculated on the original weight of the material digested. These results confirm those obtained in India.—[*Indian Trade Journal.*]

UTILIZATION OF PAPER YARNS.

Paper yarns are now being used for an extremely wide range of purposes. One of the principal uses is for the manufacture of cordage, ranging from fine twine up to coarse rope. Paper string is mostly made from paper yarn alone, but in some cases the paper is spun on a central core of fine hemp twine, and in other cases on a fine metal wire. Another important use is for the manufacture of sacks and bags to replace those made from jute and hemp. During the war enormous quantities of paper yarn have been used for making sand-bags for army purposes and for storing produce, these bags having the advantage that they are free from odour. Paper yarns are also employed for the manufacture of braiding, webbing, tent canvas, waterproof canvas, tarpaulins, mats, upholstery, carpeting materials, wall coverings, as a foundation for linoleums and oil-cloths, and for woven boards which are said to form a suitable substitute for 3-ply wood. Another use for the yarn is for the manufacture of a leather substitute, especially for machine belting. For the latter purpose the yarns are spun from parchment paper, and are afterwards wound on spools, and woven into fabrics which are stitched together to make belting of the required thickness. Paper yarns, which have been specially impregnated, are stated to be used in the cable industry, chiefly as a partial or complete substitute for jute, as a packing between the lead sheath and the iron armour of the cables. In the coating of lead-sheathed cables with waterproof composition, the winding of paper yarn is as efficient as the old jute winding, since it adheres better to the lead sheath, and blends with the composition to form a perfectly flexible and waterproof covering.—[*Indian Engineering.*]

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INDIAN FORESTER

SEPTEMBER 1919.

SOME NOTES ON THE USES OF TIMBER IN AEROPLANES.

It will perhaps be best to consider how and why an aeroplane flies, before passing to a consideration of its parts, and how wood can be used in them.

If an object is passed rapidly through the air, it displaces a certain volume of air, and causes a vacuum in its wake. The surrounding air tends to fill up this vacuum, and the object itself is attracted towards it. If the object is a flat surface then a vacuum will be formed over the rear part of it: the "trailing" part. In aeroplane construction this fact is exploited for the purpose of making the machine rise. The "leading" edge of the wing disturbs the air, and causes a vacuum over the trailing portion. The wing is so fitted to the machine, that the vacuum is all on the top surface, and therefore the wing tends to be attracted into the vacuum and to rise in consequence. The forward motion of the machine is developed from the propeller, and the tail plane gives a fore and aft balance, whilst the elevator attached to it causes the machine to rise or fall at the pilot's will. Thus the

machine flies because the propeller draws it through the air, which is disturbed and forms a vacuum over the top of the planes, which is used to lift the whole structure, but at the same time the under-surface beats against the air thus developing an additional thrust in the upward direction. The upward lift due to the suction exerted by the vacuum above the wings is at least twice as strong as the upward thrust from below the wing. Turning motion in the horizontal plane is achieved by the rudder just as in a boat.

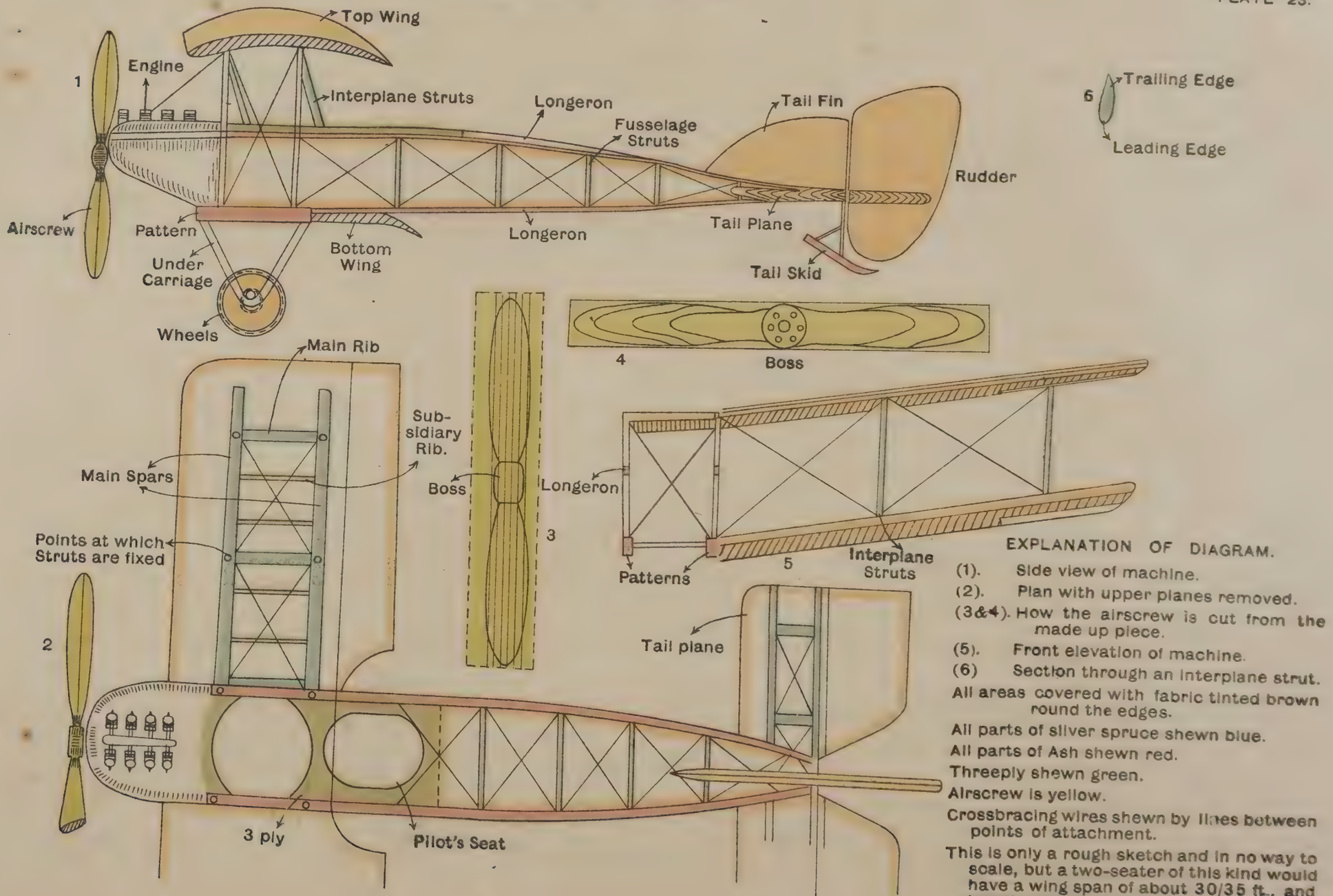
In rising from the ground, the machine runs on its wheels till it has enough speed for the forces acting on the wings to lift it off the ground. The tail can usually be lifted first, and the tail-skid, which acts as a brake, is raised from the ground. In landing the reverse process takes place, and the pilot lets his machine lose speed within a few inches of the ground till the wheels touch and tail can be depressed without causing the machine to rise, thus bringing the tail-skid hard on to the ground and using it as a brake.

In the annexed diagram (Plate 23) the parts of a B. E. type tractor biplane are roughly sketched.

Some parts of a machine are made of wood and some of metal. Everything is as light as possible, as very little weight makes a great difference in the buoyancy of a machine. The machine is built throughout on the principle of the box girder, *i.e.*, the outer sides of a four-sided figure are made of a rigid compression-withstanding material, whilst there are diagonals from each corner, crossing in the middle, of material which well withstands tension strains.

The spars and longerons in a machine are connected at intervals by struts (the outer sides of the above four-sided figure) and are cross-braced with wires or cables (the interior diagonals of the above). With one or two exceptions, the struts in a machine are all made of wood. The spars and longerons are always of wood. For these purposes, wood having the requisite strength is found to be lighter than metal. In addition, wood can be easily shaped and formed into the necessary stream-line contours. Further, wood

TIMBERS USED IN AEROPLANES.



EXPLANATION OF DIAGRAM.

(1). Side view of machine.

(2). Plan with upper planes removed.

(3&4). How the airscrew is cut from the made up piece.

(5). Front elevation of machine.

(6) Section through an interplane strut.

All areas covered with fabric tinted brown round the edges.

All parts of silver spruce shewn blue.

All parts of Ash shewn red.

Threeply shewn green.

Airscrew is yellow.

Crossbracing wires shewn by lines between points of attachment.

This is only a rough sketch and in no way to scale, but a two-seater of this kind would have a wing span of about 30/35 ft., and length of about 35 ft.

does not crystallize and weaken under vibration as metal is liable to do.

All parts of the machine, which come into contact with the air, will offer "head-resistance," if the air beats against them as the machine proceeds in its course. If this "head-resistance" and the corresponding vacuum caused are to be done away with, all such parts must cleave the air as much as possible, and leave as little vacual space behind them as possible. This object is attained by "stream-lining", *i.e.*, the part is cut to cleave in its forward passage, and to have a tail which fills its vacual cavity behind, thus preventing back suction. The air then passes by, gently lapping the part without being able to grip it. The section of an interplane strut is given.

The wings are hollow, and have a linen covering above and below, which is stretched on a wooden frame-work. This is internally braced by wires, which can be brought up to the necessary tension by an arrangement of antagonising screws. Thus the structure is on the box-girder principle as described above. The main part of the wing is in the spars, by which the wing is attached to the body of the machine. One of these is near the leading edge of the wing and one near the trailing edge. Between them are the main ribs and the subsidiary ribs. The main ribs and spars take up all the weight of the machine and all the strains of the wing whilst flying. The interplane struts are situated at the junction of a main spar and main rib. Such attachments are made by steel bolts running through the wood. The bolt heads rest on steel plates, which prevent them from sinking into the wood, and these plates are made the points of attachment for the cross-bracing wires. All the above main spars, struts and ribs are usually made of silver spruce (*Abies sitchensis*), and the interplane struts are cut to stream-line shape as described above, whilst the spars and ribs are given a girder-like section by sinking grooves on either side. These grooves are interrupted at intervals and the original thickness of the wood is left. This is done so as to retain the strength of the timber, whilst achieving the greatest possible lightness.

Between the main ribs there are a few subsidiary ribs connecting the spars. The object of these is to keep the fabric of the wings taut. They take up very little of the strains in the wing. For this reason they are very light and are made in a girder shape. The upper and lower edges are made of a single thin piece (1/8″) of alder or ash. The web connecting these parts is of three-ply. This three-ply is of ash or birch outer laminæ with a tongue of alder very often, but many kinds of wood are used for this purpose. The web is further lightened by cutting out circles of the wood, so that the rib seen from the side has a series of large holes running through it.

From the above it will be seen that all parts must be free of flaws to the greatest possible extent. Any flaw will form a centre of weakness, which will sap the efficiency of the whole member in which it is present.

In wood such flaws are usually knots, or lack of straightness in the fibre of the timbers. The safety of an aeroplane is denoted by a factor, which denotes the amount of strain greater than that which the weakest member of the machine can bear. Thus a safety factor of 10 would mean that the weakest part of the machine used in supporting it in the air would withstand 10 times that strain which would break it. As all machines are designed to have a factor of about 10, it will be seen that a bad knot in an otherwise excellent piece of timber may reduce its value to very little, as such a knot would break easily, and would tend to loosen and split if it came into vibration.

Timber used in construction must be light in the first place. For spars it must be very straight-grained and free from knots, as although very small knots are allowed, they might interfere with the drilling of the bolt holes. It must be possible to cut clean holes for the bolts, and the wood must therefore be entirely free from any inclination to split or splinter, when the borings are made. These borings are usually lined with a copper tube which is of thin metal and exactly fits the boring, whilst its own internal diameter just admits the bolt. This prevents the wood from being damaged when the bolts are taken out for dismantling the machine, etc.

For the interplane struts which are exposed to the air throughout their length the timber must be easily moulded so as to be shaped to the necessary stream-line section. They must also be highly polished. The polish is necessary, because when the air rushes over the machine there is friction between the air and the surface of the machine. To reduce this to the minimum all parts are smoothed and polished as highly as possible. This friction is called skin friction. In the same way the wing fabric has dope and varnish applied to it. The Airscrew (Propeller) is likewise smoothed and polished.

All parts of a machine made of wood are not so made to withstand compression strains only. Various parts are peculiarly liable to vibration and shearing strains. In some of the older machines the under-carriage was made of ash, because it would well withstand the vibratory strains it underwent when the machine was landing. In nearly all machines the longerons and patterns were made of ash. The longerons are the long narrow pieces which compose the fuselage and connect the wings and tail. They are held together through their length by struts and cross-bracing wires. The struts are ash or silver-spruce. The patterns are found, where the longerons pass under the body of the machine. To them the under-carriage and lower planes are fitted. The engine is carried on steel tubes in line with the top longerons; they are further supported below by a frame-work of ash struts cross-braced with wires.

When the machine is in flight, the tail is liable to be whipped slightly in almost any direction, as the machine turns, rises, falls, etc. A wood with great elasticity is required for its construction. Ash has been found most suitable for the purpose.

In every machine there are places where great pliability and strength are required for the materials used, and these must also be light. This is necessary for the purpose of shaping them to the necessary stream-line form, *e.g.*, the fuselage in front of the pilot's seat in the old B. E. type machine. For this work 3-ply wood has been found most excellent, as it can be bent in graceful curves, is light and sufficiently strong. In some machines a large

part of the fuselage towards the tail has been made of this in place of fabric. In such cases the strength of the 3-ply was sufficient to render unnecessary many of the cross-bracing wires between the longerons, as the 3-ply firmly fixed to the longerons was able to do their work.

Ash can readily be bent to various shapes under steam, and has been used for bent parts. Such bent parts do not always take quite the necessary shape to satisfy the stream-line requirements, and then mouldings are finished off by means of farings composed of such light woods as poplar, willow, etc. Such parts have only to complete stream-line contours, not to take up any of the real weight of the machine.

One very important part of the machine has not yet been touched on. This is the Airscrew or Propeller. This member is always made of wood. Its construction is of great intricacy. The strains running through it are very complex. A shearing strain runs through the arms of the propeller tending to make each part of the blade creep over that next it. To find a wood that will stand up to this a very close-grained one is required. If it were of an open grain, the various layers of the wood would tend to creep and the wood might be expected to crack along such places as the junction of two annual rings. It must also be light and capable of taking a high polish. In order that the engine might run smoothly it has to be of an even density throughout, as any variation, however slight, in the relative weight of the blades at once affects an engine revolving at the high speeds, which are developed in aeroplane motors. It was found impracticable to cut even a two-way propeller out of a single piece of timber. Accordingly layers of wood or laminæ were cut, and very firmly glued together; the final propeller being machined out of the block so formed. The laminæ are about $\frac{3}{4}''$ thick, and the number in a propeller vary according to the thickness of the thickest part. In making the propeller the laminæ of wood are laid horizontally one above the other, but so that each is at right angles to the main axis of the machine when the propeller is finished. In the finished propeller these laminæ tend to creep

over each other, and to counteract this in some cases the laminæ have been given a serrated surface. The serrations interlock when the laminæ are laid together. These serrations are quite fine (1/8″ in depth) and run along the grain of the wood.

In a 2-bladed airscrew all the laminæ are formed of single strips of wood, which are continuous throughout their length. In a 4-armed airscrew every other lamina in each blade stops at the boss, so as to allow a lamina of the other blades to be continuous from end to end. Thus only half the laminæ in each blade are continuous. At the boss all the laminæ are firmly fixed together, a single lamina of one blade passing between two laminæ of the other blades.

One of the most important attributes of the finished airscrew is its pitch. The pitch is the angle at which the working face of the propeller blade meets the air. The blade is so moulded that all parts exert an equal pull, and are under the same strain. In order that this may be so, the arm of the blade is thickest at the base and tapers down to the tip. Hence the centrifugal force developed by mere whorling tends to be the same all along the blade, as the part farthest away from the boss is the lightest. Now as the blade passes through the air it works as though it were a bolt being screwed into a nut, and the strength of its grip will vary with the pitch of its blade. In order that this may be similar all along the blade is so cut as to displace the greatest amount of air near the boss, and the pitch becomes altered up to the extreme tip, where practically no work is done at all. The tip is flat and offers the least resistance to the air, being little more than a kind of cutting edge, whilst the base of the blade offers far greater resistance, and a much flatter surface to the air as it revolves.

The edges of the blade are called the leading and trailing edges ; the leading edge being that which faces in the direction in which the blade turns, and which first cuts the air. Behind this edge the blade is stream-lined off as much as possible. The whole blade is highly smoothed, polished, and varnished, so that it may not develop friction, but merely thread its way forward.

The propeller is bolted to the engine shaft by a series of bolts, which pass through the boss, and at the same time compress the boss between two plates, back and front, whose object is to disperse the pressure of the bolt-heads, and prevent them eating into the wood. It gives them a good seating and prevents the wood from being damaged.

From the above it will be seen that timber for propellers must be able to withstand torsion and shearing strains ; be light ; take a good polish ; have resilience ; be closely grained ; readily worked ; capable of binding firmly when glued ; have a very uniform density ; not liable to split.

The wood usually used for propellers is " Mahogany. " This name Mahogany is a trade term and probably covers more than one kind of timber. In some German machines walnut has been tried. Ash has been used in alternate laminæ with Mahogany to give the blade greater spring. The propeller must have considerable spring in it, as the propeller when working full out tends to be bent forwards from the tips of the blades towards the centre.

Experiments have been tried in the direction of electro-plating the blades with copper. It was thought that this would take a high polish and would help to bind the laminæ of wood together, at the same time giving a protection to the wood against hail-stones and small pieces of soil, etc., which are kicked up as the machine starts and often dent the wood.

From the above notes it will be seen how great a part wood plays in the construction of aeroplanes. The species dealt with have been :—

Ash (*Fraxinus excelsior*) ...	for resilience, moulding under steam, compression.
Silver Spruce (*Abies sitchensis*)	for compression, moulding.
Mahogany	for torsion, shearing, moulding, polishing, resilience.
Willow	for light mouldings.
Poplar	Do.

Birch (*Betula alba*) ... for 3-ply.
Alder (*Alnus glutinosa*) ... Do.
Walnut (*Juglans nigra*) ... for torsion, shearing, moulding, polishing, resilience.

All the above are further chosen for their lightness. If woods having their strength and powers combined with greater lightness can be found, they would displace them. Can India do this?

All the above timbers have to be highly seasoned, and those which crack in seasoning or weaken or warp are useless.

Besides the above timbers used there are other forest products required :—

Rubber.
Materials for making varnish.
Fibres for fabric,

Rubber is used for wheel tyres and "shock absorbers." The wheels are carried on a light axle, which again is attached to the machine by rubber bands specially prepared in fine threads contained in a woven sheath; the finished article being about $\frac{1}{4}-\frac{1}{2}''$ in diameter for two-seater machines. These bands are wound over the axle and the under-carriage in the appointed places. They are applied in a particular way and yards are used for one machine. When finished the shock absorbers allow the wheels to bump on the unevenness of the ground without their full force being transmitted to the main body of the machine.

Varnish is used on all exposed parts of the machine. Dope is a fluid specially used for application to the fabric to make it taut after it has been attached in position. Varnish and dope also give a waterproofing effect. Varnish is often applied over the dope to reduce skin friction.

Fabric is the material with which the wings are covered and other parts of the machine. It is made of the best Irish linen.

A. N. DAVID, I.F.S.

16th April 1919.

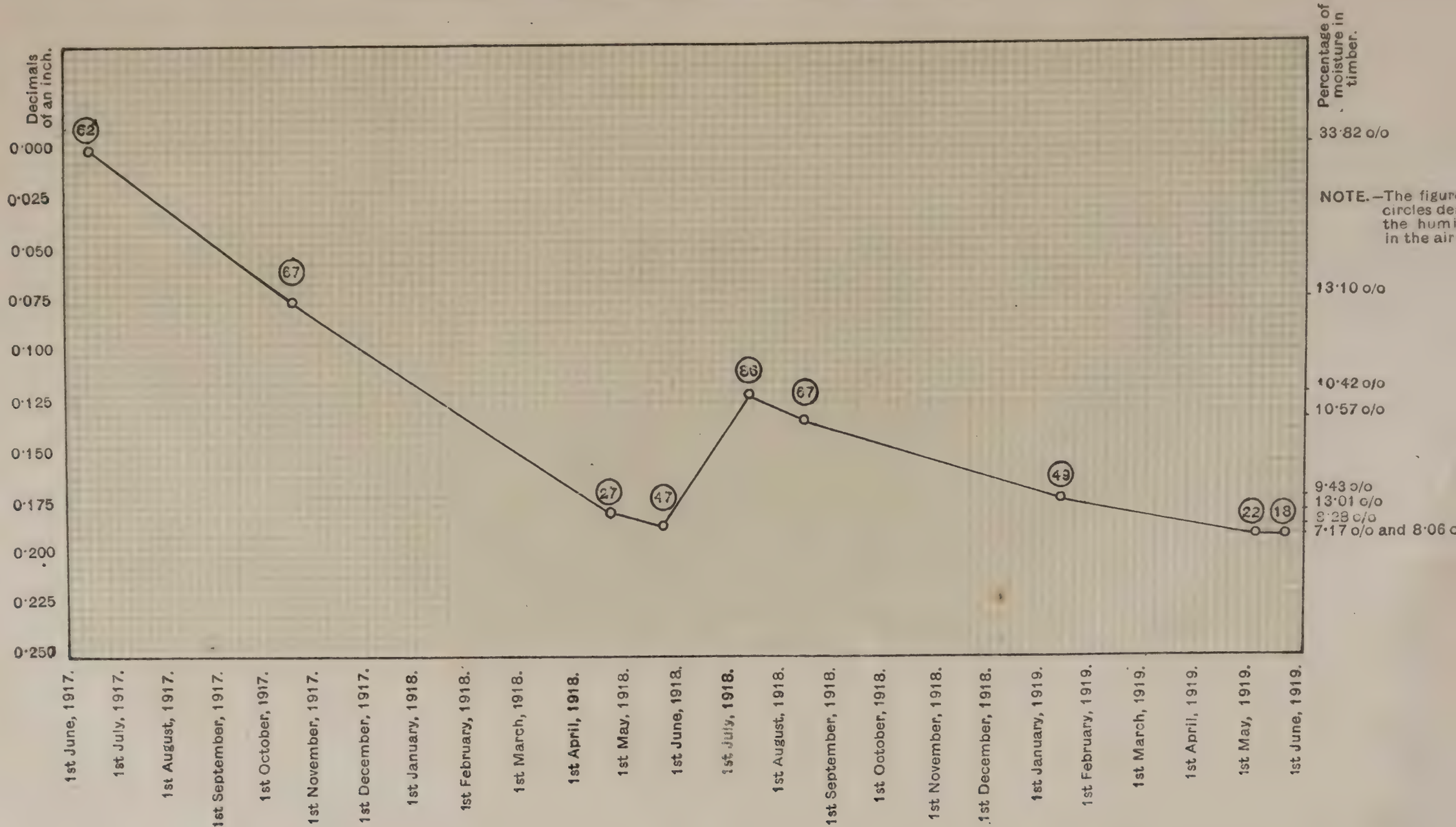
EXPERIMENT CARRIED OUT TO DETERMINE THE CONTRACTION ACROSS THE GRAIN WHICH TAKES PLACE IN TEAK *(TECTONA GRANDIS)* WHILE SEASONING.

The object of this experiment was to determine the amount of contraction which takes place in teak timber, when passing from a green to an air-dried state, and also to ascertain what effect an increase or decrease of humidity in the air had upon the timber after reaching an air-dried condition. Similar experiments have been carried out on the same lines with *Cedrela Toona* and *Pinus longifolia* timbers, with a view of ascertaining what allowances have to be made when converting those timbers when in a green state, in order that they may contract down to standard dimensions. The results of these experiments have been published in Forest Bulletins No. 15 of 1913 and No. 37 of 1917, respectively.

The machine in which the contraction experiments were carried out was that described in the former Bulletin. An average sample of Allapilli Teak from the South Chanda Division of the C. P. was selected for the experiment, cut on the quarter, to size 12″ × 12″ × 1″, and readings taken for expansion and contraction across the grain. The tree from which the plank was prepared was felled on the 31st May 1917, converted on the 2nd June 1917, and put into the machine on the 13th June 1917, at which time it contained 33·82 per cent. of moisture. Readings were taken at intervals during the next two years in the hot weather, and first two months of the monsoon at intervals of about a month and at longer intervals during the dry season. The machine is fitted with two dials and pointers marked A and B, the arms connected to which are placed roughly one-fourth of the distance from each

SPECIES.—TECTONA GRANDIS.

Curve demonstrating contraction of plank while seasoning, percentage of moisture in the timber, and percentage of humidity in the atmosphere on corresponding dates.



end of the plank. The reading on the dials, the percentage of moisture in the timber and the humidity in the air on the several dates of observation are recorded below :—

Size of plank.	Date on which readings were taken.	Reading of contraction on dial, in decimal of an inch.			Percentage of moisture on date of observation.	Humidity in the air at 2 p m.
		A.	B.	Average of A and B.		
12″ across the grain and one inch thick.	13th June 1917	...	...	...	33·82%	62
	13th Oct. 1917	0·065	0·085	0·075	13·10%	67
	20th Apr. 1918	0·175	0·185	0·180	13·01%	27
	20th May 1918	0·175	0·200	0·187	8·28%	47
	9th July 1918	0·110	0·135	0·122	10·42%	86
	11th Aug. 1918	0·130	0·140	0·135	10·67%	67
	9th Jany. 1919	0·155	0·170	0·162	9·43%	49
	2nd May 1919	0·180	0·205	0·192	7·17%	22
	20th May 1919	0·180	0·205	0·192	8·06%	18

To illustrate more clearly the state of the plank while passing from an absolutely green to air-dried condition, a curve has been prepared, which is appended to this note (Plate 24).

The maximum contraction across the grain amounts to 0·192″ or when cutting green teak an allowance of roughly 1/5″ should be made for every 12″ of breadth of planking. The allowance found necessary of *Pinus longifolia* was 1/4″, while that for *Cedrela Toona* amounted to as much as 1/2.″

On the 20th May 1918, the plank had contracted 0·187″, while on the 20th May 1919, it stood at 0·192″, or only 0·005″ difference. On the other hand during these 12 months, in the monsoon from the 20th May 1918 to the 9th of July 1918 it had expanded 0·070″, due to absorption of moisture, the humidity in the air having risen from 27 to 86. Now this experiment is of special interest in that it demonstrates the relation of expansion to air humidity and the percentage of moisture in the timber.

During the first 12 months, in spite of the plank after being laid down to season at the beginning of the monsoon, it steadily lost moisture, which resulted in uniform contraction, until in May 1918, when it had reached a thoroughly air-dried state and had contracted to nearly its maximum limit. As the humidity in the air rose with the advent of 1918 monsoon, the timber re-absorbed a small amount of moisture, *e.g.*, 2 per cent., the air humidity rose from 27 to 86 and the plank expanded 0·07 of an inch ; then as the cold weather set in and the atmosphere became dry, the moisture again evaporated out of the timber, which resulted in steady contraction until in the hot weather of 1919 the timber had dried out to 7·17 per cent. of moisture. These experiments show that even teak, after it has reached a thoroughly air-dried state, as was the case in May 1918, is not at once fit for use for high class work. As time goes on teak becomes less and less liable to be affected by climatic conditions, until it finally settles down and maintains a constant shape. How long it takes to do so is generally put at about eight years, during which period the tree has stood girdled for three years, the timber remained in the log for at least one year and during the remaining time has been stored under cover as converted material.

R. S. PEARSON, I.F.S.,
Forest Economist

The 3rd June 1919.

STANDARD SYMBOLS AND COLOURS FOR FOREST MAPS.

1. At the recent Board of Forestry in Dehra Dun a proposal was received from Colonel Sir G. P. Lenox-Conyngham, Kt.; R.E., F.R.S., for the standardizing of symbols and colours for forest maps. A copy of this is printed. The proposals did not apparently include working-plan maps. Presumably everyone will agree that this is desirable, but there will doubtless be differences of opinion as to how far it is possible to go.

I do not know what resolution the Board passed on the subject, and many of these remarks may be superfluous.

The object of this article is to start a discussion in the hope that the subject will be taken up by the next Sylvicultural Conference. Being intimately connected with working-plans, it presumably comes within their province.

2. Three principal maps are used in forest work :—The *plain standard print* taken direct from the plate.—This should show permanent items only and naturally needs symbols for everything shown. It thus gives the symbols for the items in Colonel Sir G. P. Lenox-Conyngham's Groups A, B and D without the colours, but not those in Group C. Temporary features should not be shown as, if shown, it would necessitate the preparation of a new set of plates each time such temporary features were changed, for, although a few small alterations can be made on a plate, it is not possible to make many changes.

For example, if coupe boundaries are marked on the original plate with symbols it is not possible to delete them and replace them by a new set at the revision of a working-plan. It would mean redrawing all the plates—an expensive and laborious process.

This *plain standard print* is only used by the forest staff for actual mapping work, *e.g.*, the exclusion of a new forest village, the alignment of a new road, etc.

3. *The coloured standard print.*—This is exactly the same map as under para. 2 but shows all boundaries, temporary and permanent in their colours and is the map generally used in the forest.

The alteration of the temporary boundaries at any time does not cause any alteration of the original plates, it only necessitates sur-printing the colours along the new boundaries on a set of plain standard prints.

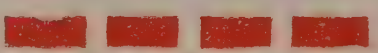
The above two maps are on the scale of 4″ = 1 mile.

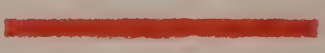
4. Some alterations should be made in Colonel Sir G. P. Lenox-Conyngham's list. Under Group B, items 4 and 8, there is a symbol for sub-compartments, that is this symbol is printed in the plain standard print and is marked on the original plate. Also the colour given on the coloured standard print is green which is the colour for *permanent* boundaries.

A sub-compartment is the most temporary of all boundaries and should come under Group C having no printed symbol, not being marked on the plate and being represented by the same colour as is used for the other working plan boundaries.

5. This necessitates an addition under Group C, and I suggest that the working plan boundaries should be shown as follows :—

Group C (4) Working Circle.

(5) Felling Series. 

(6) Coupe. 

(7) Sub-compartment.

The sub-compartment cannot be shown as red dots as it would be confused with other standard coloured symbols.

6. The colour given for the boundaries under Group C, items 1, 2, and 3, is too nearly like that for items 4 to 7. After a month in the field they might be indistinguishable. Unless it has already a standard meaning I suggest changing this colour to sepia.

7. The third map is the *Working Plan Map* and this is, in many ways, the most important of all. Its scale cannot very well be standardized as that must depend on the intensity of working. In the United Provinces these maps are often on the scale of 1″ = 1 mile, and for clearness show no contours. In hilly country, contours on this or the 4″ scale obliterate most other detail.

A working-plan map must show all ordinary details such as roads, blocks, streams, bungalows, etc. In a division where different systems are in force, the areas under the different systems should stand out at a glance on the working-plan map, and it must show in addition (1) working circle boundaries, (2) felling series boundaries, (3) compartment boundaries, (4) sub-compartment boundaries, (5) coupe boundaries, (6) compartment numbers, (7) sub-compartment letters, (8) coupe numbers.

8. It should also show if it is possible species, age, quality, and periodic blocks, though in the case of the last only the 1st 2nd and last periodic blocks need be indicated.

The point is can all items under paras. 7 and 8 be shown on one map?

9. There is no difficulty concerning the items under para. 7, items 1, 2, 4 and 5 being shown by the standard coloured lines, item 3 by the standard symbol, item 5 by a small arabic numeral, item 6 by a small letter against the compartment number, item 8 by a roman numeral, and the other items by their standard symbols without colours.

10. The difficulty comes with the sylvicultural systems and all items under para. 8. To show species by washes is an obvious solution with either age-classes or quality-classes in different shades. This, however, cannot be adopted if everything is to go on one map, because it leaves no easy way of distinguishing systems, a most important point in the U. P. at any rate, and there are too many species in India to find colours for them all.

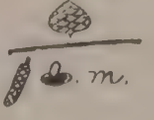
I find that it is impossible to get more than eight or ten colours which are readily distinguishable to the untrained eye after the map has been in use a month or two and to attempt different shades is quite hopeless.

A survey man will distinguish 30 or 40 different washes, but this is out of the question for the ordinary forest officer.

11. I therefore propose, as a basis for discussion, to distinguish systems by coloured washes, principal species by a symbol above a line, auxiliary species by a symbol below a line, quality by a small roman numeral in brackets, age-class by a small arabic numeral in brackets.

A symbol must be used for undifferentiated "miscellaneous species" and one for forest of mixed age.

First periodic block could be distinguished by a circle round the coupe or compartment number, second periodic block by two circles and last periodic block by a square.

Thus  (1) (20) might mean deodar in mixture with kail, oak and miscellaneous species, deodar predominating, first quality, 20 years old.

might mean Coupe XX first periodic block.

might mean sub-compartment 6a last periodic block.

12. The difficulties of this system are the number of symbols necessary for all the important species and the difficulty of remembering them. I understand, however, that symbols can be invented for all species that matter, and in any given province the number to remember would not be excessive, and there is always the reference table on the map.

13. I gather that there may be difficulties about the above in such a place as Nilambur in Madras and possibly in Burma. However, there are many other possible ways, and if the above is not applicable I hope some one will write a reply to this. Even if no system can be standardized for all India, it may still be possible to do so for the vast majority of the forests.

14. If the subject is discussed by the Sylvicultural Conference, a survey man should be present as there are many pitfalls for the unwary.

15. A few suggested colours and diagrammatic symbols are attached (*vide* Plate 25).

16. Under para. 11 I have suggested symbols for species. At present I am using letters for species, a capital letter for predominating species above a line, and a small letter below a line for auxiliary species. This is very simple and easy for one division and could probably be adopted for a whole province, but could not well be carried out for all India. It would not create confusion, however, if each province adopted its own meaning for various letters.

S. H. HOWARD, I.F.S.

12*th June* 1919.

ADDITIONAL SYMBOLS AND COLOURS FOR WORKING PLAN MAPS.

SYLVICULTURAL SYSTEMS.

Uniform system (including strip system, group system etc.)	
Selection system	
Clear cutting system	
Coppice with standard system	
Coppice system	
Improvement felling system	
Unworked areas	

SPECIES.

	Predominant.	Auxiliary.	Predominant.	Auxiliary.
Deodar		or	D	d
Kail			K	k
Spruce			S	s
Silver-Fir			F	f
Oak			O	o
Sal			Sa.	sa.
Miscellaneous, etc., etc.	M	m	M	m

QUALITY CLASSES.

First quality	(I)
Second ,,	(II)
Third ,,	(III)

AGE (AVERAGE.)

If more or less even-aged	(25)
If irregular	(Ir)

PERIODIC BLOCKS.

First	XIX
Second	XIX
Last	XIX

OTHER SYMBOLS.

Coupe number	XX
Compartment ,,	8
Subcompartment number & letter	8b

Copy of letter No. 1240, *dated Dehra Dun, the* 24*th March* 1919, *from Colonel G. P. Lenox-Conyngham, R.E., F.R.S., Superintendent of the Trigonometrical Survey, to the Inspector-General of Forests.*

I have the honour to enclose a copy of a table of symbols which it is proposed to use for forest maps, and would suggest that the proposal might perhaps be considered by the Board of Forestry which is shortly due to assemble.

Forty copies of the symbol table are sent separately in case you should care to distribute them to members of the Board and other Forest Officers.

2. The proposed symbols comprise only such items as are required for use on forest maps and which are not provided for in the list of conventional signs of the Survey of India. (I enclose a copy of the letter in case you should wish to refer to it.)

3. The object in view is to standardize the symbols and thereby to facilitate both the preparation and the reading of forest maps. The principles underlying the proposals are—(*i*) that the Survey of India symbols should be accepted, and (*ii*) that the number of additional symbols should be a minimum.

4. The black, pen-drawn, symbols in group (A) of the proposed list and the first and fifth items in group (B) are those employed in the Survey of India, the size depending on the scale of the map, the style remaining constant. The remaining symbols in group (B) and those in group (D) will, it is hoped, meet the special requirements of all forest maps. No black symbol has been provided in group (C) as these items will be conterminous with one or other of those in groups (A) or (B).

5. The colours proposed are :—

(*i*) For fiscal boundaries, a colour approximating to a neutral tint, *viz.*, Indigo.

(*ii*) For forest boundaries, the colours generally used, *i.e.*, Green and Yellow for the boundaries of Reserved and Protected forests, respectively.

(*iii*) For the limits of forest administration, a fairly prominent colour, *viz.*, Burnt Sienna.

(*iv*) For working-plan boundaries, a vivid colour, *viz.*, Carmine.

ARBORICULTURE IN INDIA.

We publish a press communiqué issued by the Local Administration of the Central Provinces on the important subject of tree planting along public roads.

The policy therein enunciated is of the greatest importance to India as a whole, and we think that the appointment of an officer of the Forest Department to advise upon and supervise arboricultural operations is one which should go a long way to establish and restore the roadside avenues, which are of such importance in this country and which appear to us to have received less attention of recent years than they deserve.

We were under the impression that the Punjab Government, some time ago, had taken steps to place the services of two forest officers at the disposal of the Public Works Department to deal with the problems which have arisen in that province, but doubtless the present shortage of staff has precluded immediate action being taken.

The importance of arboriculture is not limited to roadside avenues, a great deal can be done along canals and in civil stations, cantonments, municipalities, etc., to improve the general amenities of life and the utilization of the soil to best advantage. It is only by a competent agency that the work can be established on sound principles; thereafter continuity of action will alone achieve the desired results. We, therefore, commend the action of the Central Provinces Administration to all interested in this subject, but we would go even further and suggest that provision be made in the forest cadre of each province for the necessary superior staff to deal with this subject of arboriculture. By this means the Forest Department would always be in a position to place at the disposal of canal or road engineers a competent whole-time staff to initiate and control the work. We think, however, that the best results would be attained by placing such officers wholly under the control of the Public Works Department, as the administrative officers of the Forest Department are not in a position to look after arboricultural work in addition to their own.

AGRICULTURE DEPARTMENT, C. P.

Nagpur, the 4th June 1919.

PRESS COMMUNIQUE.

The Chief Commissioner has observed during his tours that much public money has been wasted in the past on tree-planting on public roads owing to the staff of the Public Works Department and of local bodies having an insufficient knowledge of the suitability of different kinds of trees for different soils and localities. Failure has often resulted also through ignorance of proper methods of planting and tending trees in their early years. The Manual of Arboriculture of the Central Provinces and Berar has recently been revised and widely distributed to all interested. For this revision the Administration has to thank Rao Bahadur Shrinivasulu Nayadu, M.B.E., at present Divisional Forest Officer, Seoni, who, when Divisional Forest Officer, Nagpur-Wardha, made a special study of the subject of arboriculture and achieved much success in tree-planting in the neighbourhood of Nagpur. He has incorporated in the Manual the fruits of his practical experience and the new edition should prove much more useful than the earlier ones.

The Chief Commissioner feels, however, that much good would result if Mr. Nayadu were to meet those engaged in the work of arboriculture and discuss his methods with them personally. Sir Benjamin Robertson has, therefore, decided to place him on special duty for a short period to visit district headquarters and to give instruction to the officers and subordinates of the Public Works Department and to the Engineering staff of local bodies on the subject of the wayside tree-planting and tending. It is hoped that this instruction will lead to public funds being utilized to better advantage in the future than in the past. Though Mr. Nayadu's primary duty will be to assist the officers mentioned above, the Chief Commissioner is also prepared that he should give advice to private individuals, such as large landowners, who are interested in arboriculture. Should any such desire to obtain the benefit of Mr. Nayadu's knowledge and experience, they

should address the Deputy Commissioner of the district, who will arrange with Mr. Nayadu, previous to his visit, as to the time and place at which he will give instruction to persons desiring it.

J. F. DYER,
Third Secretary to the Chief Commissioner, Central Provinces.

RAILWAYS AND FOREST FIRES.

Railway locomotives offer a very common source of forest fires, not only in the tropics but wherever such lines traverse or run alongside forests. Obviously, the methods of prevention employed in connection with other sources of fire are ineffective against this source; even fire-lines have to be modified to meet the special conditions.

The law in Great Britain is very defective in this respect, and it is certain that more stringent enactments will be passed in due course as forestry is more seriously and extensively practised in the United Kingdom. The Railway Fires Act of 1905 merely makes a railway company responsible for damage proved against it to a limit of £100 (=Rs. 1,500).

It seems very doubtful whether a railway company could be mulcted in damages under the Indian Forest Act for any fire caused by its locomotives and this is a very serious defect in the law. It is within the knowledge of many Forest Officers in India that the engine staff of running trains have been seen throwing burning waste into the scrub alongside the permanent-way with the deliberate intention of causing a fire. It is, of course, very rarely possible to prove such mischief, but it is not difficult to prove that constant fires are caused by sparks from locomotives during the dry season.

It is pleasing to foresters to find that the Canadian Government has made a real effort to tackle the problem of protection against forest fires originating from railways in statesmanlike manner and that the fairly stringent clauses of the Railway Act of 1906 (chap. 37), as amended in 1911 (chap. 22), are being worked up to.

Although it is not quite possible to apply all the provisions of this Canadian Law in India at present, there is no reason why some should not be introduced at once. In course of time, no doubt, all would be applicable. The following extracts, therefore, from "Forest Protection in Canada, 1912*":—

"From the beginning of railway legislation in Canada it has been recognized that the operation of coal-burning locomotives is a source of fire damage to adjacent property interests. The original Railway Act of 1903 contained definite recognition of the principle that railway companies must themselves bear the burden of protecting the public against fire loss due to railway operation. The extension of the application of this principle has been gradual but steady, until at the present time the provisions of the Railway Act and of the regulations issued under them comprise the most extensive and the most efficient provisions to be found on this continent for the prevention and control of railway fires by the railways themselves."

The Act gives power to the "Board of Railway Commissioners for Canada" to make orders and regulations for—

(1) the use of fire-protective appliances on locomotives;

(2) the establishment and maintenance of fire-rangers for special patrol work including equipment for fighting fires and rapid transport along the line of railway;

(3) the kind of locomotive fuel to be used;

(4) the clearing of both sides of the railway line of unnecessary combustible matter (including the eradication of noxious weeds);

(5) the financial responsibility for fire loss due to locomotives (if the railway has not been guilty of any negligence, the total amount recoverable must not exceed five thousand dollars = Rs. 15,000, otherwise it is liable to pay the full loss, deducting any sum recovered by the owner of the forest through insurance);

* By C. Leavitt, M. Sc. F., Chief Forester and Chief Fire-Inspector, Board of Railway Commissioners, Canada. Printed at the Bryant Press, Toronto, 1913, with 23 plates. The book contains other information of interest to foresters and is well worth readin .

(6) the construction and maintenance of fire traces ("fire-guards");

and all this *at the expense of the railway company*.

The first Act of 1900 having proved insufficient, a new Act was passed in 1906. The provisions, however, were not strictly enforced, and it appears that the Board of Commissioners had not utilized their powers to issue regulations until, in 1909, the Government of British Columbia applied to them "to provide additional and adequate protection from railway fires to the great forest resources of that Province." It was shown that "the use of fire-protective appliances on locomotives, as required by the 1907 order of the Board, while highly essential, did not provide sufficient protection." This application was based on the report of the "Royal Commission of Inquiry on Timber and Forestry," from which was quoted: "It is a truism that railways are the most frequent cause of fire in any timber areas through which they pass. The great majority of witnesses examined by us were somewhat emphatic upon this point."

As a result the following orders and regulations were issued by the Board:—

"....

'2. Until further orders every railway subject to the legislative authority of the Parliament of Canada, under construction or being operated by steam, shall, unless exempted by a special order of the Board, cause every locomotive engine used on the said railway, or portion of railway, being constructed or operated by it, to be fitted and kept fitted with netting mesh as hereinafter set forth, namely:—

(*a*) On every engine equipped with an extension smoke-box the mesh shall not be larger than $2\frac{1}{2} \times 2\frac{1}{2}$ per inch of No. 10 Birmingham Wire-gauge, and shall be placed in the smoke-box so as to extend completely over the aperture through which the smoke ascends, the openings of the said mesh not to exceed $\frac{1}{4}$ of an inch and 1/64 (that is 17/64) of an inch to the square.

(*b*) On every engine equipped with a diamond stack, the mesh shall not be more than 3 × 3 per inch of No. 10 B. W. G., and shall be placed at the flare of the diamond of the stack, so as to cover the same completely, the openings of the said mesh not to exceed 3/16 and 1/64, *i.e.*, 13/64 of an inch to the square.

"3. Every such company shall cause—

(*a*) the openings of the ash-pans on every locomotive engine used on the railway, or portion of railway, operated or being constructed by it, to be covered, when practicable, with heavy sheet iron dampers; and if not practicable, with screen netting dampers $2\frac{1}{2} \times 2\frac{1}{2}$ per inch of No. 10 B. W. G. .....;

(*b*) overflow pipes .....to be put into the front and back part of the ash-pans and used from the first day of April to the first day of November.....for wetting ash-pans.

"4. Every such railway company shall provide inspectors at terminal or divisional points where its locomotive engines are housed and repaired; and cause them.....:—

(*a*) To examine, at least, once a week—

(1) the nettings;
(2) Dead Plates;
(3) Ash-pans;
(4) Dampers;
(5) Slides; and
(6) any other fire-protective appliance or appliances used on any or all engines running into the said terminal or divisional points.

(*b*) To keep a record of every inspection in a book to be furnished by the railway company for the purpose showing—

(1) the numbers of the engines inspected;
(2) the date and hour of day of such inspection;
(3) the condition of the said fire-protective appliances and arrangements; and

(4) a record of repairs made in any of the above-mentioned fire-protective appliances.

The said book is to be open for inspection by the Chief Fire Inspector or other authorized officer of the Board.

(*c*) In case any of the said fire-protective appliances are found to be defective, the locomotive shall be removed from service and shall not be returned to service (during the said prescribed period) unless and until such defects are remedied.

(*d*) Every such railway shall also appoint one or more special Inspectors, as may be needed, whose duties shall be to make an independent examination of the fire-protective appliances on all the locomotives of such company, at least once each month, and report the condition of such fire-protective appliances direct to the chief mechanical officer of the railway company or other chief officer held responsible for the condition of the motive power of the said company.

"5. Any authorised officer of the Board shall have power to inspect, at any time, any and all locomotives, and may remove from service any locomotive which is found to be defective in the said fire-protective appliances; and any such locomotive so removed from service shall not (during the said prescribed period) be returned to service, unless and until such defects are remedied.

"6. No employee of any such railway company shall—

(*a*) do, or in any way cause, damage to the netting on the engine smoke-stack or to the netting in the front end of such engine;

(*b*) open the back dampers of such engine while running ahead, or the front dampers while running tender first;

(*c*) or otherwise do or cause damage or injury to any of the fire-protective appliances on the said engine.

"7. No such railway company shall permit fire, live coals, or ashes, to be deposited upon its tracks or right-of-way outside of the yard limits, unless they are extinguished immediately thereafter.

"8. No such railway shall burn lignite coal on its locomotive engines as fuel for transportation purposes, unless otherwise ordered by the Board,—lignite coal consisting of and including all varieties of coal between peat and bituminous with a carbon-hydrogen ratio of 11·2 or less, such ratio being based on analysis of air-dried coal.

"9. Every such railway company shall establish and maintain fire-guards along the route of its railway as the Chief Fire Inspector may prescribe. The nature, extent, establishment and maintenance of such fire-guards shall be determined as follows:—

(*a*) The Chief Fire Inspector shall each year prepare and submit to every such railway company a statement of the measures necessary for establishing and maintaining the routes of such railways in a condition safe from fire, so far as may be practicable.

(*b*) Such measures may provide for the cutting and disposal by fire, or otherwise, of all or any growth of an inflammable character, and the burning or other disposal of débris and litter, on a strip of sufficient width on one or both sides of the track, the ploughing or digging of land in strips of sufficient width on one or both sides of the track and such works as may, under the existing and local conditions and at reasonable expense, tend to reduce to a minimum the occurrence and spread of fire.

(*c*) Such statements of the Chief Fire Inspector shall be so arranged as to deal with and prescribe measures for each separate portion of such railway upon and adjacent to which the fire risk calls for specific treatment. The intention shall be to adjust the protective measures to the local conditions and to make the expense proportionate to the fire risk and the possible damage.

(*d*) Such statements of the Fire Inspector shall prescribe dates on which or within which the foregoing protective measures shall be commenced and completed, and the fire-guards maintained in a clean and safe condition.

(*e*) No such railway company shall permit its employees, agents or contractors to enter upon land under cultivation to construct fire-guards, without consent of the owner or occupier of such land.

(*f*) Whenever the owner or occupier of such land objects to the construction of fire-guards, on the ground that the said construction would involve unreasonable loss or damage to the property, the company shall *at once* refer the matter to the Board, giving full particulars thereof and shall in the meantime refrain from proceeding with the work.

(*g*) No agent, employee or contractor of any such railway company shall permit gates to be left open or to cut or leave fences down whereby stock or crops may be injured, or do any other unnecessary damage to property in the construction of fire-guards.

"10. In carrying out the provisions of section 297 of the Railway Act, which enacts that "the company shall at all times maintain and keep its right-of-way free from dead or dry grass, weeds and other unnecessary combustible matter," no such railway company or its agents, employees or contractors shall, between the 1st day of April and the 1st day of November, burn or cause to be burnt any ties (=sleepers), cuttings, débris or litter upon or near its right-of-way, except under such supervision as will prevent such fires from spreading beyond the strip being cleared. The Chief Fire Inspector or other authorized officer of the Board may require that no such burning be done along specified portions of the line of any such railway, except with the written permission as under the direction of the Chief Fire Inspector or other authorized officer of the Board.

"11. The railway company shall provide and maintain a force of fire-rangers fit and sufficient for efficient patrol and fire-fighting duty during the period from the 1st day of April to the 1st day of November of each year; and the methods of such force shall be subject to the supervision and direction of the Chief Fire Inspector or other authorized officer of the Board.

"12. The Chief Fire Inspector shall, each year, prepare and submit to each and every railway company a statement of the measures such railway companies shall take for the establishment and maintenance of said specially organized force. Said statements among other matters may provide for—

(*a*) the number of men to be employed on the said force, their location and general duties, and the methods and frequency of the patrol;

(*b*) the acquisition and location of necessary equipment for transporting the said force from place to place, and the acquisition and distribution of suitable fire-fighting tools; and

(*c*) any other measures which are considered by him to be essential for the immediate control of fire and may be adopted at reasonable expense.

"13. Whenever and while all the locomotive engines used upon any such railway, or any portion of it, burn nothing but oil as fuel during the aforesaid prescribed period, under such conditions as the Board may approve, the Board will relieve the said railway of such portions of these regulations as may seem to it safe and expedient.

"14. The section men and other employees, agents and contractors of every such railway company shall take measures to report and extinguish fires on or near the right-of-way, as follows:—

(*a*) Conductors, engineers or train men who discover or receive notice of the existence and location of a fire burning on or near the right-of-way, or of a fire which threatens land adjacent to the right-of-way, shall report the same to the agent or persons in charge at the next point at which there shall be communication by telegraph or telephone, and to the first section employees passed. Notice of such fire shall be also given immediately by a system of warning whistles.

(*b*) It shall be the duty of the agent or person so informed to notify immediately the nearest Forest Officer and the nearest section employees of the railway, of the existence and location of such fire.

(*c*) When fire is discovered, presumably started by the railway, such section men or other employees of the railway as are available shall either independently or at the request of any authorized Forest Officer proceed to the fire immediately and take action to extinguish it; provided such section men or other employees are not at the time engaged in labours immediately necessary to the safety of trains.

(*d*) In case the section men or other employees available are not a sufficient force to extinguish the fire promptly, the railway company shall, either independently or at the request of any authorized Forest Officer, employ such other labourers as may be necessary to extinguish the fire; and as soon as a sufficient number of men other than the section men and regular employees are obtained the section men and other regular employees shall be allowed to resume their regular duties.

NOTE.—Any fire starting or burning within 300 feet of the railway track shall be presumed to have been started from the railway unless proof to the contrary is furnished.

"15. Every such railway company shall give particular instructions to its employees in relation to the foregoing regulations and shall cause appropriate notices to be posted at all stations along its lines of railway.

"16. Every such railway company allowing or permitting the violation of, or in any respect, contravening or failing to obey any of the foregoing regulations, shall, in addition to any other liability which the said company may have incurred, be subject to a penalty of one hundred dollars (= Rs. 300) for every such offence.

"17. If any employee, or other person included in the said regulations, fails or neglects to obey the same, or any of them, he shall, in addition to any other liability he may have incurred, be subjected to a penalty of twenty-five dollars for every such offence."

The Chief Fire Inspector took action on this order without delay as the railway companies were already proceeding with plans for fire-guard (fire-traces) construction, his attention was directed

particularly to instituting an efficient system of patrols under regulations 11 and 12. In framing his instructions he was guided by the following considerations :—" Under ordinary conditions of grade and traffic, each patrolman was required to be equipped with a velocipede (hand speeder), where the fire danger was great, each man was required to make two round trips per day over his beat, which consisted of from 6 to 15 miles of track according to conditions. Where one round trip per day would suffice, the length of the patrol district was extended correspondingly. On the heaviest grades only foot-patrols were practicable, these covering from 5 to 10 miles of track each. Where the train traffic was light as on some of the lines in Southern British Columbia, and elsewhere, it was found practicable to prescribe patrols by power speeder. In this case the patrol district varied from 20 to 50 miles, according to conditions. Power speeders are, however, not practicable for patrol where there is much train traffic, on account of the danger to the patrolman. So far as practicable, track-walkers and bridge and tunnel watchmen were utilized on special patrol work, thus materially decreasing the cost to the railway company."

Extracts from the instructions will show their completeness and that the matter was taken up seriously.

" You are hereby notified that in accordance with the provisions of Order 16570 of the Board of Railway Commissioners you are required to establish upon such portions of the Canadian Pacific Railway and of the lines under its control as are hereinafter described, a force of fire-rangers fit and sufficient for efficient patrol and fire-fighting duty during the period from April 1st, 1913, to November 1st, 1913, except in so far as you may be relieved in writing from such patrol by the Chief Fire Inspector or other authorized officer of the Board.

Patrols.—The details of the patrols required are as follows, it being understood that unless otherwise specified the patrol shall be continuous between the hours of seven in the morning and six in the evening of each day, including Sundays, with a minimum patrol so far as possible of two round trips per day, one in the forenoon and one in the afternoon.

British Columbia Division.

District No. 1.

On the Mountain Sub-division (between Field and Revelstoke, 130·3 miles) the Shuswap Sub-division (between Revelstoke and Kamloops, 129·1 miles) the Okanagan Sub-division (between Sicamons and Okanagan Landing, 50·8 miles) and on the Arrow Lake Sub-division (between Revelstoke and Arrowhead, 27·4 miles) the patrol and fire-fighting work shall be done by the regular force of section men, track-walkers, and watchmen, with a minimum patrol of one round trip per day, including Sundays. No special patrol is required between Chase and Kamloops on the Shuswap Sub-division, and between Mara, Okanagan Landing on the Okanagan Sub-division. The above is based on the assumption that oil will be used exclusively as locomotive fuel during the fire-season, and that the right-of-way will be maintained in a condition free from inflammable material, as required by section 297 of the Railway Act. Should either of these conditions not be fulfilled to the satisfaction of the Fire Inspector for the Railway Belt, additional measures will be prescribed by him and may include any of the special measures relating to the above portion of your line enumerated in my letter to the Company, dated June 15th, 1912. In particular, a special patrol shall be provided by the Company, following 30 minutes after any coal-burning locomotive passing over any portion of district No. 1 in the daytime.

Special attention is required on the part of the Company with regard to clearing the right-of-way, since there is a considerable amount of inflammable material along some portions of the line where the danger of fire from sources other than locomotives will necessitate special patrols unless said section 297 is strictly complied with. This matter is under consideration by the Board and will be made the subject of a separate letter.

District No. 2.

(1) *Thompson Sub-division.*—Between Drynoch and North Bend, 42·3 miles, the patrol and fire-fighting works shall be done

by the regular force of section men, track-walkers and watchmen; minimum patrol of two round trips per day, including Sundays.

.....

(3) *Cascade Sub-division.*—Between North Bend and Waleach, 53·4 miles, four men with velocipedes, distributed as follows:—

Between North Bend and mileage 14, 14 miles;
Between mileage 14 and Yale, 13·1 miles;
Between Yale and Hope, 13 miles;
Between Hope and Waleach, 13·3 miles.

Should the right-of-way not be cleared to the satisfaction of the Fire Inspector for the Railway Belt, such additional measures shall be taken as shall be prescribed by such Fire Inspector.

Whenever oil shall be used exclusively as locomotive fuel on any portion of the above lines, and satisfactory compliance with section 297 of the Railway Act shall have been secured, relief will be granted in whole or in part from the above special requirements, upon application to the Fire Inspector of the Railway Belt.

District No. 3.

.....

Between Castlegar and Shields, 13·3 miles, one man with velocipede.

Between Shields and Mile Point 41·8, 2·8 miles, one foot patrolman who may also be bridge watchman.

Between Mile Point 41·8 and Mile Point 50, 8·2 miles, one foot patrolman.

Between Mile Point 50 and Mile Point 55, 5 miles, one man with velocipede, who may also be bridge watchman.

.....

GENERAL PROVISIONS.

So far as practicable, the work of patrol has been combined with the other regular duties of the employees, but where this action has not been specifically indicated the patrol force is to be a specially organized and specially supervised body of men, who shall perform, to the exclusion of other duties, the patrol and other fire-protective work indicated in the Regulations of the Board and specified herein.

In every case where special or section patrols are required, special instructions must be issued and special supervision must be provided by the company.

As a matter of record, velocipede patrolmen passing telegraph stations shall be reported the same as passing trains and such records shall be freely open to the inspection of any authorized officer of the Board.

Each foot patrolman shall be equipped with one shovel and one canvas bucket. Each velocipede patrolman shall be equipped with 2 shovels, 2 canvas buckets and one axe. In addition to the above, and to the regular section equipment, there shall be stored at the tool house for each section and each patrol district the following emergency fire-fighting equipment: one axe, 3 mattocks and 4 buckets of not less than 12 quarts capacity each. Equipment for the transportation of patrolmen will also be furnished by the company as indicated."

.....

Finally the following draft instructions to be issued by the several railway companies to their employees were framed:—

"To Enginemen, Conductors, Brakemen and Firemen:

It shall be the duty of train and engine crews on freight and passenger trains, when discovering a fire, on or adjoining the right-of-way of the Railway Company, to stop and use every effort to extinguish such fire. In the event of this being impracticable, either by reason of the extent of the fire or its distance from the right-of-way, the train shall proceed to the first telegraph station, where the conductor shall wire a report to the Superintendent, giving the exact location of the fire, and the action taken by engine and train crew concerning the same. It shall also be the duty of the enginemen to stop and notify the first section gang passed, regarding any fire not extinguished as above.

No employee shall do or cause damage or injury to any of the fire-protective appliances on any engine; open the back dampers of any engine while running ahead, or the front dampers while running tender first, or permit fire, live coals or ashes to be

deposited on tracks or rights-of-way outside of yard limits unless the same are extinguished immediately thereafter.

To Agents:

The enginemen and conductors of all trains have received instructions to report fire along the right-of-way and adjacent thereto, and it shall be your duty to notify the local Fire Inspector of the Railway Commission immediately, giving the exact location of the fire and its extent, and forthwith wire the Superintendent, giving the location of the fire, the extent of the same, and any other information which may be of value particularly as to the number of men needed to extinguish the fire.

To Roadmasters, Assistant Roadmasters, Master Carpenters and other officials:

In cases where fires are reported, it shall be the duty of any divisional official to proceed to the scene of the fire as quickly as possible and to take charge of the work of fire-fighting until he can be relieved by the Division Roadmaster. The man first on the ground should organize his men to do the best work possible and when this is done, he should immediately proceed to investigate the origin of the fire, and fix the location where it started; get statements from all witnesses, and make every effort to learn the origin and fix the responsibility. The law, as now interpreted, practically makes this company responsible for fires starting within 300 feet of the track, unless it can be shown that the company is not responsible. It is necessary, therefore, to determine positively the origin, in order to relieve the Railway Company of the responsibility. The first officer on the ground should endeavour to hold a joint investigation with the local Fire Inspector of the Railway Commission, or other local forestry officer, and agree upon the origin of the fire. This will avoid disputes later on.

To Chief Despatchers:

In all cases where fires are reported, it will be the duty of th despatcher to get full information as to the extent of location, and the number of men necessary to fight it. It will also be the duty of the despatcher to furnish whatever train service may be required to move extra gangs, section gangs, or bridge crews, to

the fire immediately, giving this movement preference if the emergency requires it.

To Section men, Extra Gangs and Bridge Foremen :

In all cases where fire occurs, it shall be the duty of all section crews, extra gangs and bridge crews to proceed immediately to such fires, and extinguish the same, remaining as long as may be necessary to do this ; and it must be understood that this is the most important work that can be done, and that the carrying on of your work, though it may be important, must be set aside until the fire is extinguished. The section foreman, on whose section the fire occurs, shall, in the absence of an official of the company, make a thorough investigation regarding the origin of the fire, and submit a full report to the Roadmaster.

Between April 1st and November 1st no ties, cuttings, débris or litter upon or near the right-of-way shall be burned, except under such supervision as will prevent such fire from spreading beyond the strip being cleared. Officers of the Railway Commission may require that no such burning be done along specified portions of the line, except with the written permission or under the direction of such officer.

During the fire-season of 1912 two hundred fires were reported as starting within 300 feet of the tracks of railways under the jurisdiction of the Railway Board, which burned over 25,148 acres ; these figures do not include prairie fires. These fires are classified as follows :—

Cause.	No. of fires.	Kind of land burnt over.	Acres.	Property destroyed.	Value.	
					Dollars.	Rs.
Trains	164	Grass or cultivated land...	4,135	Young growth ...	51,655	1,54,965
Camp and casual fires. ...	12	Young forest growth ...	17,017	Standing timber ...	17,175	51,525
Unknown ...	24	Timber land ...	1,322	Forest products in process of manufacture ...	650	1,950
		Slashing or old burn not re-stocking ...	2,674	Railway property not covered in above ...	18,250	54,750
				Other private property...	750	22,50
Total ...	200		25,148		88,480	2,65,440

Undoubtedly some of the measures detailed above could be introduced at once and many of the others later on. It is for Forest Officers to urge the necessity on the authorities, where the danger is greatest.

April 1919. C. FISCHER, I.F.S.

THE FOOD PLANTS OF INDIAN FOREST INSECTS.

BY C. F. C. BEESON, M.A., I.F.S., FOREST ZOOLOGIST.

PART IV.

(*Continued from* Indian Forester, *pp.* 312—323.)

LAMIIDÆ.

Apomecyna histrio, Fahr.

Borer.—*Tinospora cordifolia.*[39]

Distribution.—[India ; Malaya.]

Apriona cinerea, Chev.

Bark eater and girdler.—*Morus indica.*

Heartwood borer.—*Morus indica.*

Distribution.—[New Guinea] ; Siwaliks, U. P.

Apriona germari, Hope.

Bark eater and girdler.—*Ficus infectoria, Morus indica.*

Heartwood borer.—*Morus indica. Morus alba,*[44] *Broussonetia papyrifera.*[44]

Distribution.—[Sylhet] ; Lahore, Punjab ; Mussoorie, Almora, Siwaliks, U. P.; Tonkin.

Apriona rugicollis, Chev.

Wood borer.—*Morus alba.*[40]

Distribution.—[Japan ;[40] Burma.]

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[39] Lefroy, 1910, p. 153.

[44] Duport, 1913, p. 989.

[40] Bureau of Agriculture, Tokyo, 1913.

Aristobia approximator, Thoms.

Bark girdler.—*Lagerstræmia Flos-Reginæ.*

Borer.—*Anona* sp.[41]

Distribution.—[Malaya]; Sylhet, Sibsagar, Khasias, Assam Southern Shan States.

Aristobia birmanica, Gahan.

Bark girdler.—*Lagerstræmia Flos-Reginæ.*

Wood borer.—*Tectona grandis.*

Distribution.—[Karen and Kachin Hills, Bhamo, Rangoon]; Katha, Shwegu, Tharrawaddy, Pyinmana, Burma.

Batocera albofasciata, De Geer.

Heartwood borer.—*Castilloa elastica,*[42] *Erythrina indica,*[42] *Ficus elastica, Ficus hispida*[42].

Distribution.—[Indo-Malaya.]

Batocera roylii, Hope.

Heartwood borer.—*Mangifera indica.*

Distribution.—[India]; Siwaliks, U. P.; Shillong, Assam.

Batocera rubus, Linn.

Shoot girdler.—*Albizzia Lebbek,*[43] *Hevea braziliensis,*[47] *Moringa pterygosperma.*[48]

Heartwood borer.—*Bombax malabaricum, Erythrina indica, Ficus carica, Ficus elastica,*[49] *Ficus glomerata,*[50] *Mangifera indica.*

Distribution.—[Indo-Malaya; Africa; Mauritius; West Indies, etc.].

Batocera titana, Thoms.

Heartwood borer.—*Mangifera indica.*

Distribution.—[India]; S. Shan States, Karen Hills.

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41 Fletcher, 1917, B, p. 257.

42 Dammerman, 1913, p. 33.

43 De Charmoy, 1914.

47 Duport, 1913, Henry, 1915, Green, 1916, and Fletcher, 1917, B, p. 36.

48 Fletcher, 1917, B, p. 299.

49 Ballou, 1916.

50 Fletcher, 1916, p. 10.

Cœlosterna scabrator, Fabr.[54]

Bark eater and girdler.—*Casuarina equisetifolia, Shorea robusta.*

Heartwood borer.—*Acacia arabica, Casuarina equisetifolia.*[51]

Distribution.—[India.]

Cœlosterna spinator, Fabr.[54]

Bark eater.—*Pyrus Malus*,[52],[53] *Rosa* sp.[52], [53]

Heartwood borer.—*Acacia arabica*,[52] *Casuarina equisetifolia*,[52] *Zizyphus Jujuba*[53].

Distribution.—[India.]

Coptops ædificator, Fabr.

Heartwood borer.—*Amoora Rohituka, Bauhinia Vahlii, B. variegata, Buchanania latifolia, Garuga pinnata, Odina Wodier, Shorea robusta, Spatholobus Roxburghii.*

Distribution.—[India ; Ceylon ; Java ; Africa.]

Dihammus fistulator, Germar.

Heartwood borer.—*Coffea* sp.,[55] *Ficus elastica*,[55] *Theobroma Cacao.*[55]

Distribution.—[India ; Ceylon ; Malaya ; Andamans.]

Epepeotes luscus, Fabr.

Heartwood borer.—*Artocarpus integrifolia*,[55] *Castilloa elastica*,[55] *Ficus hispida*,[55] *Mangifera indica, Theobroma Cacao.*[55]

Distribution.—[Burma ; Siam ; Malacca ; Borneo ; Java ; Sumatra.]

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[54] Confusion appears to exist between *Cœlosterna scabrator*, Fabr. [Sp. Ins., I, p. 224 (1781)] and *C. spinator*, Fabr. [Suppl. Ent. Syst., p. 145 (1798)]. Stebbing, 1914, relying on an identification by Gahan considers *spinator* as a variety of *scabrator*. Lefroy, 1909, and Fletcher, 1914, treat the two as distinct species. The Research Institute collection contains specimens of each species with various host records, but as the authority for identification is unreliable I have omitted them in this list.—C. F. C. B.

[51] Fletcher, 1914, p. 326.

[52] Fletcher, 1914, p. 325.

[53] Fletcher, 1917, B, p. 254 ; p. 265.

[55] Dammerman, 1913, p. 33.

Epepeotes uncinatus, Gah.

Heartwood borer.—*Ficus elastica.*

Distribution.—[Karen Hills, Burma; Assam, Sikkim]; Tista, Bengal.

Glenea galathea, Thoms. Var. Nov.

Sapwood borer.—*Gmelina arborea, Tectona grandis.*

Distribution.—[Japan]; Myitkyina, Katha, Burma; Kanara, Bombay.

Glenea indiana, Thoms.

Sapwood borer.—*Tectona grandis.*

Distribution.—[India]; Sikkim, Khasias, Assam; Pyinmana, Tharrawaddy, Karen Hills, Burma.

Glenea 14—maculata, Hope.

Sapwood borer.—*Pinus excelsa, Pinus longifolia.*

Distribution.—[Sylhet]; Rawalpindi, Kangra, Punjab; Chakrata, Almora, Naini Tal, Garhwal, Siwaliks, U. P.

Glenea multiguttata, Guer.

Sapwood borer.—*Boswellia serrata, Odina Wodier.*

Distribution.—Belgaum, Kanara, Bombay; Bangalore Madura, Madras; Chindwara, C. P.

Glenea spilota, Thoms.

Sapwood borer.—*Bombax malabaricum.*

Distribution.—[Burma; India]; Siwaliks, Kheri, U. P.; Jalpaiguri, Bengal; N. E. Frontier, Assam.

Haplohammus cervinus, Hope.

Heartwood borer.—*Tectona grandis.*

Distribution.—[Japan; China; Assam; Nepal; N. India]; Karen Hills, Myitkyina, Katha, N. Shan States, Pyinmana, Toungoo, Burma.

Haplohammus punctifrons, Gahan.

Heartwood borer.—*Ficus elastica.*

Distribution.—[Karen Hills, Tenasserim]; Lakhimpur, Assam.

Mecotagus tigrinus, Oliv.

Heartwood borer.—*Ficus elastica.*

Distribution.—[India]; Tista, Bengal; Kanara, Bombay.

Moechotypa verrucicollis, Gahan.

Bark-eater.—*Hevea brasiliensis* [56].

Distribution.—[Bhamo, Burma; Ceylon]; Siwaliks, U. P.

Monochamus bimaculatus, Gahan.

Heartwood borer.—*Dalbergia Sissoo.*

Distribution.—[Bhamo, Tenasserim, Burma; Siam]; Siwaliks, U. P.; Buxa, Bengal.

Monochamus nivosus, White.

Heartwood borer.—*Calotropis gigantea, Kydia calycina.*

Distribution.—[U. P.: Nepal, Central and Southern India; Burma; Ceylon.]

Nupserha variabilis, Gahan.

Sapwood borer.—*Tectona grandis.*

Distribution.—[Siam; Tenasserim, Karen Hills, Bhamo, Rangoon]; Toungoo, Burma.

Olenecamptus bilobus, Fabr.

Sapwood borer.—*Artocarpus blumei, Ficus Carica,* [57] *Ficus elastica, Ficus glomerata, Ficus Rasburghii, Mangifera indica.* [58]

Leaf eater.—*Ficus* spp.

Distribution.—[Sumatra; Java; Siam; Indo-China; Bhamo, Tenasserim]; Siwaliks, U. P.; Bengal; Kanara, Bombay; S. India.

Olenecamptus curvipes, Gahan.

Sapwood borer.—*Anogeissus latifolia.*

Distribution.—Bombay; Kurnool, Madras; Indore; Gonda, U. P.

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[56] Rutherford, 1914, p. 41, and Green, 1915.

[57] Fletcher, 1917, B, p. 251; p. 337.

[58] Dammerman, 1913, p. 33.

Sthenias grisator, Fabr.

Bark-eater and girdler.—*Chloroxylon Swietenia*, [59] *Erythrina indica*, [60] *Morus alba*, *Nerium odorum*, [60] *Rosa* spp., *Tabernæmontana alba*, *Vitis Vinifera*. [60]

Distribution.—[India; Malaya.]

Xylorrhiza adusta, Wiedm.

Bark-eater and girdler.—*Premna* sp., *Wrightia tinctoria*.

Distribution.—[Madras; Ceylon; Bhamo, Karen Hills]; S. Shan States, Toungoo, Burma.

LUCANIDÆ.

Cladognathus giraffa, Fabr.

Borer of decaying wood.—*Picea Morinda*, *Quercus* sp.

Distribution.—Chakrata, Mussoorie, Dehra Dun, Naini Tal, Lansdowne, U. P.; Darjeeling, Chittagong Hills, Bengal; Khasia Hills, Assam; Andamans.

Dorcus antæus, Hope. [61]

Borer of decaying wood.—*Quercus incana*.

Distribution.—Naini Tal, U. P.; Kurseong, Darjeeling, Bengal; S. Shan States, Burma;

Eurytrachelus reichei, Hope. [61]

Borer of decaying wood.—*Rhododendron* sp.

Distribution —Naini Tal, U. P.; Darjeeling, Kurseong, Jalpaiguri, Bengal.

Hemisodorcus nepalensis, Hope.

Borer of decaying wood. *Cedrus Deodara*, *Quercus* sp.

Distribution.—Chakrata, Mussoorie, Tehri Garhwal, Almora, Naini Tal, U. P; Darjeeling, Kurseong, Bengal.

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[59] Jour. Bom. Nat. Hist. Soc., 191, XXIII, p. 767.

[60] Fletcher, 1917, B, p. 251; p. 337

[61] D'Abreu, 1915, p. 41, says the "genera *Dorcus* and *Eurytrachelus*" are to be found in large numbers in hollow and decaying trees, chiefly "sauer" (*Betula cylindrostachys*), "musre katus". (*Castanopsis tribuloides*) and "kharani" (*Symplocos theæfolia*), in the Darjeeling Himalayas.—C. F. C. B.

Lucanus cantori, Hope.

Borer of decaying wood.—*Betula cylindrostachys,* [62] *Castanopsis tribuloides,* [62] *Symplocos theæfolia.* [62]

Distribution.—Darjeeling, Kurseong, Bengal; Khasia Hills, Assam.

Lucanus lunifer, Hope.

Borer of decaying wood.—*Machilus* sp., *Quercus dilatata, Quercus incana.*

Distribution.—Simla, Punjab; Chakrata, Mussoorie, Dehra Dun, W. Almora, Naini Tal, U. P.; Khasia Hills, Assam.

Lucanus mearssi, Hope.

Borer of decaying wood.—*Symplocos theæfolia.*

Distribution.—Mussoorie, U. P.; Darjeeling, Kurseong, Bengal.

Nigidius distinctus, Parry.

Borer of decaying wood.—*Macaranga pustulata.*

Distribution.—Buxa, Bengal; N. Shan States, Burma.

Prosopocoelus budda, Hope.

Borer of decaying wood.—*Picea Morinda.*

Distribution.—Chakrata, Dehra Dun, U. P.; Darjeeling, Bengal.

PASSALIDÆ.

Leptaulax dentatus Fabr. [63]

Borer of decaying wood.—*Bombax malabaricum, Ficus elastica, Shorea robusta.*

Distribution.—[Darjeeling, Buxa, Jalpaiguri, Bengal; Nepal; Bhutan; Goalpara, Lakhimpur, Chittagong Hills; Cachar, Assam; Pegu, Tenasserim, Tavoy, Burma; Andamans; Indo-China; Malaya, etc.].

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[62] Recorded by Stebbing, "Injurious Insects," p. 34, and "Forest Zoology," p. 80, but not in "Indian Forest Insects," 1914; recorded by D'Abreu, 1915, p. 36, apparently on the first authority.—C. F. C. B.

[63] "Leptaulax darjeelingi, Knw." Stebbing, 1914, p. 67.

Ophrygonius cantori, Perch.

Borer of decaying wood.—*Betula cylindrostachys, Carpinus viminea, Castanopsis tribuloides, Machilus odoratissima, Quercus* sp., *Symplocos theæfolia.*

Distribution.—[Kulu, Punjab; Chakrata, Naini Tal, West Almora, U. P.; Tista, Darjeeling, Kurseong, Bengal; Sikkim; Bhutan; Naga Hills, Khasia Hills, Assam; Ruby Mines, Bhamo, Burma; Tonkin.]

Tiberioides kuwerti, Arrow.

Borer of decaying wood —*Juglans regia.*

Distribution.—[Nepal; Darjeeling, Bengal; Bhutan; Naga Hills, Assam; Burma.]

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RED WOOD OF HIMALAYAN SPRUCE (*PICEA MORINDA*, LINK).

The Himalayan spruce has no true heart-wood but the inner wood is sometimes found to be red in colour and it is often asserted by forest officers that this red wood will not float.

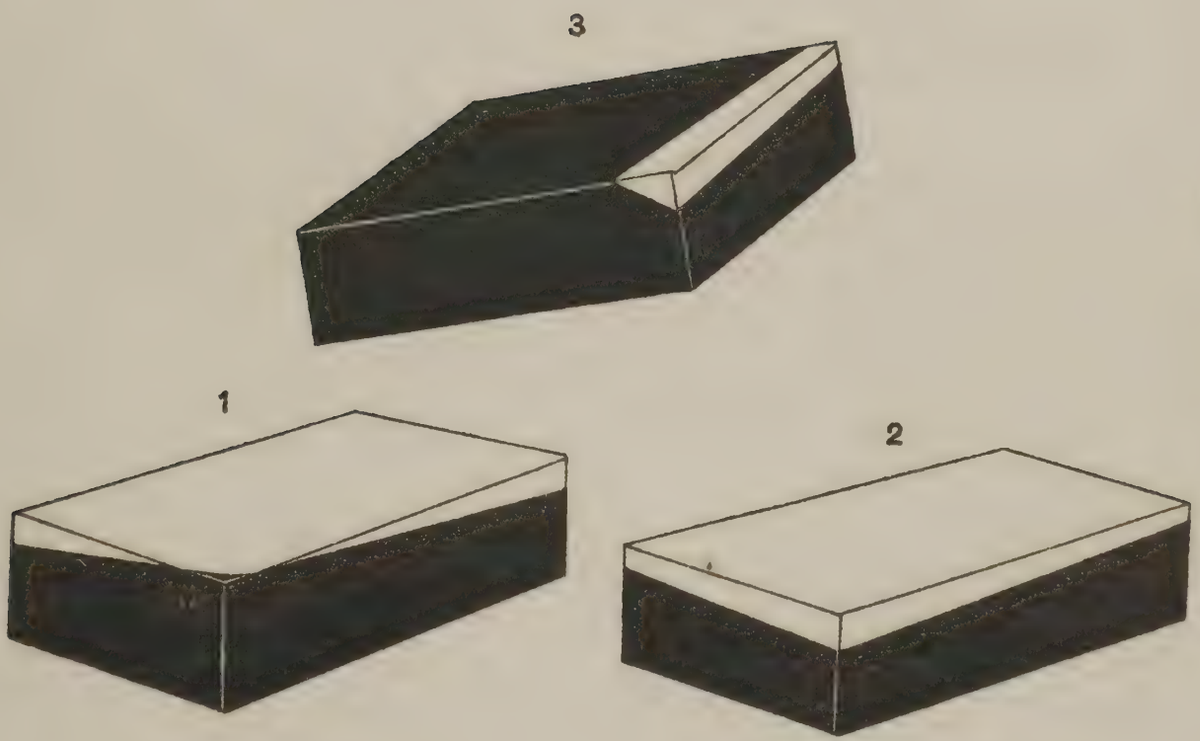
An investigation to discover the cause of this discolouration is now in progress at Dehra Dun, the occurrence of which appears to be analogous in some respects to that of brown oak in Europe, recently reported upon by Prof. P. Groom (*Ann. Bot.*, Vol. 29, p. 393, 1915).

The present paper, however, merely deals with a small experiment, which has been recently carried out at Dehra Dun, to test the water-absorbing capacity of white and red spruce wood respectively.

The wood specimens were received from Mr. H. M. Glover, Deputy Conservator of Forests, Bashahr, Punjab.

Three blocks were cut of approximately the same size and shape, and after being weighed were placed in water in a big enamelled basin in the Dehra Dun Laboratory on September 25th, 1918. It was noted at the start that the red blocks, being heavier in weight than the normal white block, sank deeper when put into the water, but at the close of experiment the reverse was the case. The white block which originally floated much higher in the water had now almost entirely sunk, while the red blocks had sunk very little deeper than at the beginning. The black portions in the figure (Plate 26) represent the parts of the blocks which were below the water surface at the close of the experiment on 5th April 1919.

At the close of the experiment the blocks were re-weighed and re-measured to see if any difference as regards their weights and measurements had taken place after the immersion in water. As regards the measurements, the differences were very slight, but there was a good deal of increase in weight as the following statement shows. The white wood had absorbed the larger quantity of water, and was about three times its original weight. On the other hand, the red blocks absorbed comparatively little water :—



1 and 2 Red blocks. 3 White block.

Black area represents the immersed part.

No. of Blocks.	Weight in grammes.			Measurement in millimeters.			Total cubic contents of wet blocks at close of Expt.	Cubic content of wood above water surface at close of Expt.
	Before putting in water on 25-9-18.	At close of Expt. on 5-4-19.	Difference.	Before putting in water on 25-9-18.	At close of Expt. on 5-4-19.	Difference.		
1 Red Block ...	368·7	628	+259·3	153×93·75×51	154×95·5×52·5	+1×1·75×1·5	772·12 cc.	124·5 cc.
2 Red Block ...	373·2	660	+268·8	153×94×51·5	154×96·5×52·25	+1×2·5×·75	776·49 cc.	125·5 cc.
3 White Block ...	259·6	760	+500	152·75×93·75×51·25	153×96×52	+·25×2·25×·75	763·78 cc.	9·5 cc.

From the above it will be seen that the red wood is heavier, volume for volume, than the normal white wood, but after soaking both specimens in water for the same length of time the white wood becomes much heavier, volume for volume, than the dark wood ; hence the water absorbing capacity of the red wood is, in fact, less than that of the normal white wood.

In connection with the above, the following statement by Mr. R. N. Parker (*Forest Flora of Punjab*, 1918, p. 541) is interesting :—

"This brown timber (of spruce) is said by contractors not to float but experiments in floating sawn specimens in a tank made by the Divisional Forest Officer, Chakrata, and by myself showed that the brown timber floats as well as the white."

In the light of these experiments it is hoped that local officers will undertake some further experiments on a larger scale with the object of definitely testing the truth of the local idea as to the red wood not floating.

This work was taken up at the suggestion of Mr. R. S. Hole, Forest Botanist, to whom the writer's best thanks are due.

A. HAFIZ KHAN,
Assistant to Forest Botanist.

5th May 1919.

DOES FIRE, OR EXPOSURE OF TREES GROWING UNDER SHADE, OR DAMAGE TO HOSTS LEAD TO SPIKE DISEASE IN SANDAL.

In the December number of the *Indian Forester*, Mr. Fischer records his observations on sandal saplings burnt on fire-lines at Horsleykonda, a hill rising to 4,322 feet with a rainfall of 30 inches, where the sandal was not indigenous but introduced.

"It seems very doubtful," says Mr. Fischer, "that injury by fire will lead to spike in sandal in a locality where spike does not already exist on that species."

The following observations are made with reference to an area which has a rainfall of about 140 inches and an elevation varying from 50 to 380 feet :—

In Shankernaraina Range of South Kanara District, North Mangalore Forest Division, sandal is indigenous in some of the coupes of the Mavinaguli block and also in the unreserves on both sides of the Neralcatta-Sabladi road.

Coupe No. V of Mavinaguli block was burnt in 1917-18, and in February of 1918-19 and during March of the latter year I inspected the area. Twenty-four sandal trees were severely burnt. Again in November 1918, I inspected the coupe as I had orders from the District Forest Officer to extract these trees and send them to Mangalore Depôt. Trees Nos. 8, 11, 14, 17 and 20 had leafy shoots springing from the stem at the bottom, and in no case were there less than three shoots to the stem. Another severely burnt tree, which was not numbered, had sent forth five shoots from the bottom of the stem and two shoots from the stem 2 feet from the bottom.

On inspection of these trees in February 1919, I found the height of the shoots to average 3′6″ and the growth to be very healthy. The stems had been burnt to the extent that the bark had fallen off close to the bottom of the stems except in two cases in which the bark remained to a height of one foot from the bottom ; and the branches were all dead.

In most of the unreserves above referred to, there are annual fires, but so far no case of " spike in sandal " has been observed, and Mr. Fischer's doubt appears to be justified by the facts in this locality.

Another factor which was mentioned in the October number of the *Indian Forester* as a probable cause of spike in sandal was the exposûre of trees hitherto grown under shade.

In coupe VII of Mavinaguli block there are about 200 sandal trees of 6″ in girth and above. Most of these trees were growing under heavy shade until 1916-17, the year in which the coupe was worked. Under the method of " coppice-with-standards " an average of 20 standards only was left to the acre including some sandal trees, and all other growth was cut.

Coupe V of the block already referred to above with reference to fire was similarly worked in 1915-16, and in this there are now 302 trees of and over 6″ in girth.

In these cases, although the sandal trees were suddenly exposed no tree has yet shown any signs of spike, and the facts at least in this particular locality do not support the theory that exposure will lead to disease where it does not already exist.

Another conclusion suggested by the above facts is that damage to or death of hosts does not necessarily lead to spike disease, since it is evident that in a coupe of about 65 acres in which all growth except 20 standards per acre has been cut back, damage to hosts must necessarily have taken place.

It is perhaps the case that stumps of coppiced trees are more active in spending their stored-up nutriment in the production of shoots than in encouraging the haustoria of sandal roots to parasitise upon them, unless the popular theory of root parasitism of sandal is wrong ; but if injury or damage to hosts in any area is due to fire, wind or general drought, sandal trees thereon must also be affected independently of their hosts.

(Sd.) C. KARUNAKARA MENON,
Dated 23rd February 1919. *Forest Range Officer.*

PROVINCIAL FOREST TRAINING SCHOOL, UNITED PROVINCES.

Final Examinations.

The final examination came off as usual in the last week of June 1919 at Naini Tal, the written part of it having been held from 23rd to 25th and oral from 26th to 28th June. The Board of Examiners consisted of Messrs Oliphant, Marriott, Clifford, Herbert, Deputy Conservators of Forests, and Messrs. Sita Ram Puri and Keshab Datt Joshi, Extra-Assistant Conservators of Forests, and myself All the 30 students who appeared in the examination succeeded in obtaining certificates. Two medals were offered by Government and one prize by the Officer in charge of the School for competition among the students and these were awarded as follows :—

(1) Medal for the " First student in the Class " to Tulsi Ram Bahuguna, Forester, South Garhwal Forest Division.

(2) "Forestry Medal" for the "First student in Sylviculture in the class" to Tulsi Ram Bahuguna.

(3) "Prize for merit" to Trivikram Singh, Forester, North Garhwal Forest Division.

Certificates and prizes were distributed to the students by Mr. Leete, Chief Conservator of Forests, U. P., on 2nd July 1919, and very instructive speeches were delivered by him and Mr. Canning, Conservator of Forests, Western Circle, United Provinces.

The Officer in charge also gave a short speech in which he thanked the Conservator of Forests, Western Circle, for taking a keen interest in the School affairs.

One of the students, on behalf of the class, thanked the Government and the Officers who had deputed them to the School for bettering their future prospects. The whole party was then photographed and the function came to a close.

MD. HALIM-UD-DIN,
Extra-Assistant Conservator,
I/C U.P. Forest Training Class.

NAINI TAL:
10*th July* 1919.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester.*

VALUATION OF A SAL FOREST.

SIR,

In the May number of the *Indian Forester* "BEEANDOH" asks for valuations of a Sal forest giving the following statistics :—

Growing stock—

Class I	5′—6′	*Nil.*	
„ II	4′—5′	4,284	trees.
„ III	3′—4′	6,356	„
„ IV	2′—3′	13,920	„
„ V	1′—2′	74,560	„

Area—876 acres.

Class I tree yields 26·6 c.ft. timber worth 2 annas per c.ft.
Class V tree reaches class I in 90 years.
„ IV „ „ „ I in 76 „
„ III „ „ I in 52 „
„ II „ „ I in 26 „
Rate of interest 4½ per cent. per annum.
Value of miscellaneous trees, fixed arbitrarily = Rs. 777. Cost of maintenance = 2·13 annas per acre per annum.

The forest is presumably to be managed as a Selection forest. Such being the case, the usual method of estimating its value, namely, by adding together the soil expectation value and the value of the growing stock cannot be used as there are not sufficient data for determining the soil expectation value. The simplest method, therefore, is to estimate the income that may be expected from the forest and capitalize it to infinity deducting from it the expenses capitalized to infinity. In doing so the following facts have to be borne in mind :—

Firstly, that the whole of the existing growing stock cannot be expected to reach maturity. The maximum number of class I trees to be found per acre in a Sal selection forest is about 12 and therefore only 10,512 trees of classes IV and V can ever reach maturity. The balance will be removed in sylvicultural operations and one can assume, somewhat arbitrarily, that the cost of such sylvicultural operations will be paid for by the value of the timber removed, and can, therefore, be ignored in the calculations. Secondly, if the forest is not to be managed as a Selection forest and as many as possible of the IV and V class trees are to be allowed to reach maturity, it is still hardly likely that more than 12 per acre will do so. Thirdly, the estimate of outturn of I class trees includes unsound trees and presuming as seems likely that only apparently sound trees were enumerated, no great error will be made in assuming that the whole of class II and class III trees will reach maturity. Fourthly, the 2·13 annas to be allowed annually for maintenance per acre is for protection and exploitation only and does not include any sylvicultural operations. Fifthly, it must be assumed that any other class

of trees which arises later than class V now existing will take 24 years to reach class V. This assumption can make little difference either way.

The present value of the income from the forest will therefore be—

Class II trees Rs. $\frac{4284 \times 26{\cdot}6}{(1{\cdot}045)^{26} \times 8}$ = Rs. 4,534

„ III „ „ $\frac{6356 \times 26{\cdot}6}{(1{\cdot}045)^{52} \times 8}$ = „ 2,635

„ IV „ „ $\frac{10,512 \times 26{\cdot}6}{(1{\cdot}045)^{76} \times 8}$ = „ 1,231

„ V „ „ $\frac{10,512 \times 26{\cdot}6}{(1{\cdot}045)^{90} \times 8}$ = „ 665

„ I(a) „ „ $\frac{10,512 \times 26{\cdot}6}{(1{\cdot}045)^{114} \times 8}$ = „ 226

„ II(a) „ „ $\frac{10,512 \times 26{\cdot}6}{(1{\cdot}045)^{138} \times 8}$ = „ 78

The present value of any other yields is found by summing the series $a + ar + ar^2$, etc., to infinity.

When $a = \frac{10,512 \times 26{\cdot}6}{(1{\cdot}045)^{162} \times 8}$ and $r = \frac{1}{(1{\cdot}045)^{24}}$ and equals Rs. 42.

The present value of the whole income of the forest is therefore Rs. 9,411.

The present value of the cost of maintenance is found by summing to infinity the series $a + ar + ar^2$, etc.,

when $a = \frac{2{\cdot}13 \times 876}{16}$ Rupees and $r = \frac{1}{1{\cdot}045}$ and equals Rs. 2,708.

The value of the forest is therefore Rs. (9,411 + 777 − 2,708)

= Rs. 7,480

= Rs. 8·54 per acre.

3rd July 1919. R. LOWE.

GEOLOGY AND FOREST DISTRIBUTION.

SIR,

Having read with interest Mr. Smythies' article on the relation between plant growth and geology, I wonder if he can solve a little problem for me. In a neighbouring area the underlying

rock is a limestone sometimes mephitic with a curious pisolitic structure, occasionally with numerous cherty concretions and sometimes oolitic. Can Mr. Smythies tell me what to grow there? How about radishes?

2nd July 1919. INTERESTED.

LEAVES OF *BUTEA FRONDOSA*.

SIR,

I was camping the other day near a grove of Palas *(Butea frondosa)* but the leaves of the trees were simple, not trifoliate. This variation from normal is new to me. I had so far only struck Palas with yellow and white flowers.

C. A. MALCOLM,
I. F. S.

SAUGOR:
9th July 1919.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Yemané plantation of 1916.
The tree in foreground measures 1′-8″ in girth and 36′-6″ in height.

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YEMANÉ (*GMELINA ARBOREA*) IN UPPER BURMA.

A full description of this species and its timber has been given in Mr. A. Rodger's "Note on Gumhar" published in 1913 as *Forest Bulletin* No. 16.

During the past few years experiments have been made in the regeneration of *Gmelina* in Katha Division, and its introduction is now being attempted on a fairly large scale in the Northern Circle

The following are notes on the results of some of these experiments and on the methods now being tried, in the light of the experience gained in Katha.

First a few facts may be mentioned regarding the growth of *Yemané* in natural forest in this region. It is widely but sparingly distributed over the plains and lower hills in the northern wet zone, extending to above 3,000 feet wherever conditions are favourable. Its soil and drainage requirements resemble those of teak, but it probably needs more moisture and has less objection to soils with a tendency to waterlogging: it is not found on dry

sandy soil, and attains its finest growth on rich alluvium with good drainage, where it may reach a girth of 8 to 10 feet and a height of 100 feet : unsound stems are rare, except when trees are clearly overmature.

It is seldom a shapely tree, often branching low down and with a bole anything but vertical : logs are not often obtainable over 20 feet long and these are frequently curved. This difficulty of obtaining good logs has certainly contributed to the comparative obscurity of so fine a timber.

The branchy habit is due to the fact that normal branching takes place from all leaf axils concurrently with the year's shoot, so that when the leader is damaged, shoots on one or more already developed branches take up the growth and result in forks standing out at 60° or so from the main stem : this is a common character of the decussate habit, but is in contrast with teak, in which a new leader is formed from a main leaf axil and grows nearly vertically. This feature of *Yemané* has to be taken into consideration in pruning operations, and is referred to later.

The distribution of mature trees is never gregarious : in some forests one can say with truth that wherever one stands at least one *Yemané* tree is in sight, but it is often still more scattered. The fruit is produced annually in fair quantity and, like that of Spondias, is usually distributed far and wide by game, so that seedlings seldom survive in any quantity near the mother trees. These which do germinate are, again, so liable to the depredations of game that they are seldom in evidence, and it is even possible that their extreme scarcity in reserves is due to the protection the Forest Department affords to sambur and barking-deer.

Climate.—In Katha Division the rainfall varies between 50″ and 80″ of which about 90% falls in the 6 months, May to October, showers occurring almost invariably in November and April and occasionally in the remaining months. Dry warm winds occur in March and April, but alternate with moister spells and very occasionally raise the shade maximum above 95° ; 80° is rarely touched between early November and late February ; but the minimum seldom falls below 40°. Dews are heavy throughout

the cold season and persist even in April in clear weather, such a climate favours luxuriant vegetation and a long growing season, and while showing its effect in the remarkably fast growth of tree species, produces a growth of weeds and grass scarcely imaginable by Forest Officers in drier regions. The altitude at which regeneration work has been done varies from 500 to 1,500 feet above M. S. L.

Methods of Regeneration.—Three methods have been tried—transplanting from nurseries, dibbling, and broadcast sowing, and each of these methods is represented in the instances selected as types in these notes

But before describing the results, the following remarks may be made on seed collection and treatment.

The tree in this region flowers in February and March, and fruit begins to fall about the third week in April, being large and conspicuous it is very easy to collect without special measures. Spreading trees with plenty of fruit are selected and visited every two or three days, most of the fruit that falls being thus saved from game. Fruits are put out in the sun as they are collected, and the fleshy integument rots in a few days, separation being assisted by beating with heavy bamboos.

Cleaned seed can thus be obtained in fair quantity by the middle of May, by which time sowing should be done at the latest. Seed collection is done by villagers who are paid Rs. 2-8 to Rs. 4 for each basket of seed ready cleaned—one basket weighs 45 lbs. and contains about 48,000 seeds. No particular care was taken in the preparation of nursery beds beyond raising them slightly to ensure good drainage. Seeds were not put in thickly, but were pressed in with the finger about 4 inches apart. If seedlings are required for cold weather planting (described below) nurseries should be sown in September: if for the following season, sowings can be done even later. Seedlings were planted out when from 9″ to 1′ high; those that were sown too early were found to have grown much too big. Transplanting was not done with any special care as the seedlings recovered quickly and stood being moved even in dry weather.

History and Results of Regeneration Work.—*Yemané* was first tried in Katha in mixture with teak in concentrated regeneration, the object being to retain fairly equal stocking of each species through the rotation. Teak and *Yemané* were planted in alternate lines 9′ feet apart on clear felled and burnt areas, and weeded and tended to effect equal survival of both species.

In every case before the end of the first rains *Yemané* had asserted itself as the dominant species, and during the second rains had to be cut back to enable the teak to push up through the rapidly closing net-work of side branches. After this it was decided to abandon the teak rows and leave the *Yemané* to itself, and the experiment was given up.

About this time (1916) the idea of equal mixture of teak with other species began to give way to the doctrine of pure blocks, and *Yemané* was one of the trees selected to be grown in "chunks" to mitigate vast expanses of teak. It was also expected that this species would be cheap to grow owing to its ability to form canopy rapidly and save expense in weeding, though its probable value financially as a principal crop was only vaguely foreseen.

In 1916 plantations were made in several places: the most successful one is now described. In February 1916 a flat area was cleared under girdled teak seed-bearers, and a corner of this set aside for *Yemané* owing to its strong grass growth. After burning in April, *Yemané* plants sown a month earlier in a nursery were put out 6′ × 6′ about the end of May. These were kept weeded during the rains of 1916, and by November are said to have averaged 4′ to 5′ high over the greater part of the area—only about 1½ acre in all. In the adjacent plot, similarly cleared and burnt, teak plants had been put in and weeded in the same way but showed much less height growth: they had also given trouble by dying off and having to be replaced by new plants.

In the subsequent rains (1917) the *Yemané* began to show its value. An early weeding was done concurrently with the teak, but by July the crowns were beginning to close and suppress the grass and no more weeding was necessary. By the cold weather of 1917-18 an average height of 22 feet had been attained and the

undergrowth consisted of nothing but suppressed Pollinia grass and shade bearing annuals up to 4 feet high. In February 1918 the plantation was visited by the Inspector-General of Forests who considered the crowns too congested and recommended a heavy thinning at once. This thinning was done in April 1918, but before this a sample plot of 2 square chains was marked out and 229 trees counted, the completeness of stocking being remarkable.

Eighty-eight trees were removed in the thinning (38½ per cent.) which was made in the canopy only, suppressed trees being left standing. The 141 trees remaining were found to have an average girth of just over inches at 4½ feet and 5 of them had attained 1, foot the largest a girth of 1′ 2½″ and a height of 25 feet. After the rains of 1918 it was decided to remove the suppressed stems left in the sample plot, and 43 more trees were cut out. The 98 stems thus remaining were found in January 1919 to have an average girth of 11″ (the elimination of suppressed stems does not vitiate this figure appreciably), and 34 of them were 1 foot in girth and over. At the same time 11 stems at good distances were selected in this plot and marked as permanent sample trees. The girth of these 11 trees when measurements were taken a year ago was traceable from records, and was found to have increased from 11·2″ to 14·7″. The largest tree had increased from 15″ and 27′ to 20″ and 36′ 6″ in girth and height respectively.

In this plantation the great majority of the trees are straight grown, and closeness of spacing has kept branching within bounds.

The usual wealth of branches was produced, but all those on which the leaves were prevented from obtaining light died off at once, and could be knocked off with a stick like those of pine. This is an important point, and makes it uncertain whether a 6′ × 6′ plantation might not with advantage be left unthinned for a year or two longer, so as to obtain a clean bole of 45 or 50 feet. But from the present instance it seems that the strength of the thinning was not excessive, as the crowns in the thinned portion are still fairly small and show no signs of spreading at the expense of the leading shoot. In this case the cost of establishment and

tending of the *Yemané* was not kept separate from the teak, but is estimated at Rs. 8 per acre for the three years : that of teak and *Yemané* together was Rs. 19 per acre but whereas the teak was weeded for three rainy seasons, the *Yemané* needed no tending after it had been through a month of the second rains.

The two photographs of this 1916 plantation here reproduced show clearly the distinction between the portion thinned and that left unthinned.

Other examples of the establishment of *Yemané* by nursery transplants can be given.

In 1918 an area under very heavy elephant grass on which teak regeneration had failed seven years previously was cleared and burnt for stocking with *Yemané*. A number of nursery plants remained over from 1917, but excessively close sowing had kept back their height growth to about 1′ 6″ and caused a number to be weak and suppressed. These plants were used, and it was hoped that by early planting up with such seedlings the grass could the better be kept under. This proved to be the case, and by the end of the season some had reached a height of 8 feet. But this experiment was not altogether successful : the burning in March was too early, and transplanting, which might have been done in April, was postponed to the end of May in order to allow some refuse teak to be extracted from the area. The result was that grass was already well re-established when planting was done at 6′ × 6′, and weeding was necessary from the very beginning. If the grass had been cut and burned later and planting done at once, results must have been more favourable, and if such a grass area is to be stocked with transplants there is no doubt that, in a locality where burning cannot usually be done after April, yearling plants can be put out sooner and must give the best results.

In the same year (1918) *Yemané* was tried with a *taungya* crop of paddy, nursery plants being put out at 6′ × 6′ at the end of May concurrently with the rice sowing. Success was complete, plants attaining 6 to 8 feet in places. But if this method is adopted late planting is an advantage, as forward plants are apt to grow branchy and interfere with the paddy crop.

The mention of late planting leads to another experiment of which the result is not yet certain. Owing to success obtained in moving some plants to fill gaps in the middle of a dry November (these were found to recover at once from the check of transplanting) the idea was conceived of the possibility of winter planting. Heavy elephant grass was at once cleared on an acre plot and burnt at the end of November. Nursery seedlings from 6″ to 1′ high were put out, and, to make matters safe, the planting holes were filled with water and earth filled in round the roots before the water subsided. A hundred seedlings were, however, planted out without water as a test. This plot was watched throughout the dry season. Most of the seedlings recovered at once and did not drop their leaves till March, when new growth began : in some the leader died and fresh shoots appeared from near ground level. No watering was done, and no rain fell till April, March being exceptionally dry and hot for the locality. In April a few plants were found to have died as a result of the excessive drought in March, but those planted without water suffered no worse than the others.

Countings will be made to ascertain the rate of survival, and possibly 10 per cent. may be found to have succumbed, but the experiment may be said to have been successful as far as it has gone, and in future such work will be begun earlier—end of October or early November—and only the strongest nursery seedlings used.

The object of this method is the establishment of a crop of *Yemané* seedlings in areas liable to be covered with a heavy growth of grass, at a season when grass growth is in abeyance and no weeding is needed, so that when grass growth is resumed the *Yemané* will have already started its new growth, and will be pushing ahead at its strongest at a season when it would under normal circumstances be suffering the check of transplanting. It is hoped that thereby weeding expenses will be much reduced and that none will be necessary in the latter half of the coming rains. Possibly even broadcast sowing in the early cold weather may prove successful. Nursery beds sown in a level moist spot near a

stream, in December 1918, were at once well stocked with seedlings, which survived and began fresh growth in March without watering. If sown in October seed would have germinated even in drier places, and in a season of normal winter rainfall would probably have survived. The experiment of broadcasting at this season, however, remains to be made, and even if successful can hardly show great advantage over the summer sowings to be described.

The luxuriance of grass and weed growth in such a locality as Katha points every time to the necessity for anticipating it by early establishment of the crop of *Yemané*. This leads to the question whether seed can be sown at periods up to a year after its collection. This is under investigation, and was first suggested by the appearance of natural seedlings in clearings under seed-bearers well in advance of the ripening of the year's fruit. Hitherto all that has been ascertained is that most of the seed of 1918 is certainly still fertile, and some of it sown in nurseries early in April has already germinated. Comparative tests will be made, and if successful, no doubt the policy of using none but year-old teak seed will be adopted in the case of *Yemané* also, for spring sowings. The importance of early germination is accentuated in a climate where vegetation begins early, and the ripening of tree seeds is if anything later than in drier localities.

Dibbling.—This method has not been tried on a large scale in Katha, but two instances are worth describing.

A large plot of ordinary mixed forest, fairly flat, was cleared and burnt in April 1918. Owing to early rain the fire was a poor one, except where two or three large clumps of *Wapyu* bamboo (*Dendrocalamus membranaceus*) had been cut and gave a fierce blaze, part of this area was dibbled 6′ × 6′ with *Yemané* seed, four or five to each peg, in the middle of May. Germination started within ten days, and seedlings were weeded ; but where the fire had been weak soft weeds and Pollinia grass proved very troublesome from the beginning and in some cases overwhelmed the young plants. On the other hand, where the bamboo clumps had been burnt, roots and grass rhizomes seem to have been completely

destroyed, and no weeding was found necessary throughout the rains except the removal of small cucurbitaceous ground creepers. Partly for this reason and partly, without doubt, owing to the good manuring effect of the ash *Yemané* plants made remarkable progress, several reaching a height of between 11 and 12 feet by the end of the rains, and forming a complete canopy. Such extraordinary growth had not been attained by transplants—even when plants from the former year's nurseries were used.

The other case was very difficult. An area under a thick growth of *Thetké* (Imperata) grass was cut in February and burnt in March. Seed was dibbled in like manner in May, by which time the new grass was already fairly strong. Only about 50 per cent of the pegs showed plants in the first month, and it was supposed that crickets had devoured the young seedlings before they appeared above ground. Plants that germinated showed very poor growth, few of them reaching 2 feet in height in their first season and all appearing unhealthy. The influence of the grass may be fairly suspected in this case, as it is of course a notorious pest in rubber plantations. The nursery plants put in here to fill blanks showed similar poor growth, though repeated weeding was done, but it is hoped that the grass will eventually be overcome and the *Yemané* will go ahead in the end.

Broadcast sowing.—One experiment in this method was made in 1919 and met with remarkable success. A hillside on which a *taungya* crop of rice had been grown in 1917 was selected, a "*ponzo*" which in another year would have been covered with secondary growth of softwoods of no value. It was hoped that closely sown *Yemané* on cleared ground would, with some assistance, get the better of such growth and establish itself fairly cheaply.

In April 1918 weeds were cut and an attempt made to burn them, but, except where paddy straw was fairly thick, this was not a success, intermittent rain also interfering. Finally, late in May, unburnt débris were removed and the soil lightly raked over, and *Yemané* seed of that year was sown broadcast at the rate of one basket 45 lbs.) to the acre. The weather being rainy, germination started within a week, and the soil was soon covered with *Yemané* seedlings

to the entire exclusion of weed growth. Except in places where straw had been scanty and no fire occurred, absolutely no weeding had to be done throughout the rains, and when the writer saw the place in October the whole hillside was a solid mass of *Yemané*, its stems as dense as corn and the soil under its shade clear of everything but a few procumbent creepers. Growth was not so rapid as in the dibbled plot already mentioned, but in places the canopy was 8 to 9 feet high. In so crowded a crop it was not surprising to find girth sacrificed to height, though there were already indications that certain stems would become dominant without further tending.

A remarkable feature in this case was the refusal of any of the young *Yemané* plants to be suppressed. Hardly a stem did not share in the canopy ; even where 3 seedlings grew from one fruit, each of them had its crown of leaves 7 or 8 feet above ground.

The proper treatment of such a crop after its first year is certainly a system of annual thinnings until, say, an average interval of 8—10 feet is reached, *viz.*, for three or four years. But the cheapness of the method will probably lead to its adoption over considerable areas, and such thinnings may prove impracticable. In this area, therefore, the effects of two extreme treatments are to be tried.

A fully stocked plot of 1 square chain was taken in January 1919 and thinned heavily, some 80 per cent. of the stems being cut out. The spacing appears ample, and it is hoped that no further thinning will be needed for two years at any rate. Even after the thinning there are 330 stems left, which suggests that many more might have been cut out but for the inevitable branching that would ensure at the expense of height growth.

It may be mentioned that the heavy pollard-growth that will shoot from the cut stems will be effectual in keeping down weeds in the coming rains, so there is no fear from that quarter.

The other treatment consists merely of leaving the crop at its present density for another season at least, in the hope that the potentially dominant stems will prove well enough distributed and will be able to assert themselves. In a square chain, of which

one corner was almost blank, 1,374 saplings were counted, and full stocking estimated as 16,000 per acre.

The value of broadcasting, if success on this scale is assured, lies in its extreme cheapness of establishment on localities subject to heavy weed growth, where no assistance can be obtained from field crops. Such a method of re-afforestation in "*ponzo*" (old taungya) could be adopted without further delay, limited only by the amount of *Yemané* seed that can be collected : and, if it proves practicable to leave such crops to themselves without fear of deterioration, the value of the scheme will be doubled. *Ponzos* of over one year's standing would of course give more trouble owing to the greater strength of the secondary growth, but would probably differ only in needing one or two weedings in the first half of the rains. Attempts are to be made in a second year *ponzo* in Katha this year by way of experiment.

The cost of establishment per acre on the one-year-old *ponzo* described can be analysed thus—

	Rs.	a.	p.
Collection of one basket of seed (cleaned)	2	8	0
Clearing, burning and raking soil ...	0	12	0
Sowing seed	0	4	0
Total ...	3	8	0 per acre.

In this case one basket per acre was used, but it is probable that the use of half a basket would be equally successful if carefully sown.

In teak *taungyas* in Katha a new method is to be adopted this year to take the place of the planting, dibbling, or broadcast sowings hitherto in practice, and *Yemané* will also be sown in the same way as an experiment.

The method is as follows :—Bamboo tubes are provided to each sower, and seeds are sown through the tubes, which are rested on the ash covered soil, and then roughly trodden in by the foot, 3 or 4 seeds are sown at each spot, and can be directed by means of the tubes into suitable places, *e.g.*, stumps, rocks and other unprofitable things will be avoided, and on steep slopes ledges

or hollows can be selected for the reception of seed. Intervals can be regulated as required, but usually will be one pace or approximately 3 feet. No attempt will be made to sow in straight lines, and pegs will only be used to mark the spot where seeds are sown, being put in after sowing by a cooly following the sower, these pegs will show the progress of sowing, and will be small and of a temporary nature, there being no necessity for them to survive for countings after the paddy is reaped.

If *Yemané* seeds are sown 3 at a time at 3 feet intervals, about half a basket will be used on an acre, and with normal germination at least one plant at each peg should be assured even if only 2 seeds are sown. The drawback of broadcasting are avoided, such as difficulty of control and heavy seed expenditure with uncertain distribution, and, by being pressed in, the seed stands less chance of desiccation or non-germination owing to resting free on the surface of the ground.

Dangers to which Yemané is liable. – Hitherto no insect has appeared doing material damage in plantations except the problematical cricket already mentioned, which confined its energies to an area under *thetkè* grass. But one very serious danger has shown itself all too prevalent in Katha, and that is sambur. All the Katha plantations have suffered except those in the vicinity of human dwellings, even saplings 12 feet high being broken down by the animals in search of green shoots and leaves. Severe sambur grazing, which is almost confined to the cold weather, results in the complete smashing of the young tree so that no remedy but coppicing is possible: moderate grazing may only affect some of the shoots, but the leader seldom escapes if less than 8 feet from the ground.

If a rudimentary shoot on the main stem is available pruning can be done and a sapling allowed to grow on, but more often it is preferable to coppice. As far as is known, *Yemané* coppices well if cut back early in the season, but some sapplings cut back by the writer about the middle of June were a complete failure.

An effectual method of keeping sambur away from *Yemané* areas has not yet been found, but many devices remain for trial

and the trouble is certainly not insuperable. It is, however, more serious than might be imagined: a *Yemané* plantation seems to attract all the sambur from a whole country-side, and hitherto the ordinary paddy-field method of clappers worked from a hut has not succeeded. Next season trial is to be made of bamboo rope entanglements, a single-rail fence, painted white, tins streamers and what not, not to mention patrolling with guns, and it is hoped that outright fencing will not prove a necessity. Methods such as scarecrows, clappers, and even beating, are only temporary in effect, and useless when the beasts really mean business. Bison have also been detected as destructive, but need not usually be feared.

Curiously enough, cattle seem to be averse to *Yemané*. In two cases in Katha bullocks and cows are regularly grazed among young *Yemané* and refuse to touch it: in fact their presence is looked on as beneficial in keeping down weeds and grass. Even in the dry season, when sambur grazing is at its worst cattle in these forest regions can find plenty to eat, and seem to dislike *Yemané* as much as they do teak. Ponies also refuse it, so there must be something distasteful in it.

This may seem remarkable to those whose experience of grazing is confined to the drier parts of India, but in Upper Burma, except in the dry zone, there is seldom any lack of green fodder, and its superabundance in young regeneration areas is leading to the encouragement of grazing, especially in teak regeneration, to save expense in weeding.

The only other serious "danger" hitherto noticed in the Katha *Yemané* areas was the hailstorm of 5th April 1919, which almost completely stripped one of the best of the plantations of last year of its new shoots, the leaders being already a foot long on some of the trees. But most of these trees will recover without coppicing, and several such storms every year would be preferable to the visitations of sambur.

Rate of Growth and Rotation.—The rate of girth increment for the first three years in the planted area described first promises well for short rotation working of a very valuable timber

tree. The writer, after seeing the third year's growth, made a rough estimate of the probable future increment, allowing for considerable slowing down and arrived at a rotation of 30 years for a mean girth of 6 feet and about 100 trees on the acre. In order to get something substantial to go on seven good average free-growing *Yemané* trees were felled in natural forest, and information obtained from them as to rate of growth.

These showed an average girth at breast height of 4′ ½″ and an average age of 21 years, but owing to difficulties in early youth averaged only 9″ (with bark) at three years. The mean girth of the 11 sample trees in the 3-year-old plantation mentioned above is 14·7″ after three years, and if a future increment parallel to that of the natural trees, *viz.*, 3′ 3½″ from the 4th to the 21st year is assumed to take place in the mean sample tree, it would attain 4′ 6″ in 21 years. Continued growth with the same mean annual increment of 2·2′ would bring it to 6′ girth at an age of 29 years.

Such calculations are of course based on slender data, but there is no reason to suppose that the natural trees taken were not typical: they varied considerably, the fastest grown being 4′ 6″ in girth in 20 years and the slowest 2′ 11″ in 19 years, and it is probable the growth of plantation trees will approximate to the faster rate and even exceed it. It is, therefore, reasonable to suppose that a mean breast girth of 6 feet in 30 years will be attained in suitable localities.

Whether fast growth is a good quality in *Yemané* timber is not known, but there is nothing in its structure to lead one to suppose it is not. European oak and ash are the more valuable if fast grown, and wide-ringed teak stands weathering much better than that with congested rings. Nor can we yet say on what rotation it will pay best to work *Yemané*. If the manufacture of matches is to be considered, a girth of 4′ 6″, reached say in 17 years, would probably be at the top of the financial rotation curve. If planking for furniture and building purposes is the main demand, 6′ girth with bark should be quite enough It is fairly certain that the enormous squares required in the case of teak will not be needed.

Photo.-Mech. Dept., Thomason College, Roorkee.

Year 1916 plantation of 1916 at Kalsaura, Kotha Division. Thinned portion on right.

Further, it may be found that short-length timber produced by very heavy thinnings every four or five years, and consequently enhanced girth increment, and shortened rotation, may pay best.

But whatever may be the decision on points of management there can be no doubt that this tree if grown under such conditions must form an exceedingly profitable crop, well worth growing on a considerable scale, provided that localities well suited for export are selected, and floating will always be the cheapest extraction method of light timbers, whatever the future may bring forth either on land or in the air.

KATHA. C. G. E. DAWKINS, I.F.S.

ARTIFICIAL REGENERATION IN SAL FORESTS.

Now that uniform systems of management are being more and more employed in Sal forests of the United Provinces, artificial regeneration has become a question of great importance. Not very long ago an article appeared in the *Indian Forester* describing the system of planting in vogue in the Gorakhpur division, so it is not proposed to describe this again in any detail, but merely briefly to state the main points. Plants are raised in a nursery and when they are about two or three years old,—the stage of development reached rather than the age being of paramount importance,—they are planted out in holes dug in the forest. Before planting the roots are pruned to a depth of 1 ft. 6 inches and the stem to only a few inches above the ground. One point which also needs repetition is the proved necessity for constant attention, weeding and working the soil, during the rains for at least the first three years after planting. Plants put out in this way in the early rains of 1916 are all doing well and look quite healthy, but their development is not yet very satisfactory, the average height now being only about 1½ feet and the best developed about 2 feet. The average height of coppice shoots, on the other hand, it very roughly about 15 feet in four years. From this it is quite clear that the planted sal cannot compete with coppice shoots, at least certainly not for many years, although subsequently the reverse

may be expected and the plants will probably develop into finer trees than those obtained from coppice. It is now a known fact that until the root system is properly developed the young plant either dies back every year or remains merely alive but does not appreciably develop in height.

The areas under the uniform system in Gorakhpur are worked on a 40 years rotation and $\frac{1}{40}$th of the area is clear felled every year. After the felling a sea of grass and weeds comes up, mixed with the sal and coppice shoots of other species. Where the crop is good the coppice shoots quickly come through and the grass dies away, but this is not the case in the blanks and poorly stocked places. Accordingly, where planting and sowing have to be done to fill up the area, a very heavy grass growth has to be contended with and the expense of keeping the young plants clear is very considerable. Also the smaller natural seedlings on the ground get either smothered by the grass or suppressed by the quick growing coppice. The necessity for having a good percentage of natural grown or planted trees on the area, and not having the whole stock composed of coppice shoots need not be harped on.

To sum up, the disadvantages of sowing and planting after the fellings are, owing to the slow development of artificial regeneration, as compared with coppice shoots :—

(1) The difficulty and expense of tending owing to the resultant heavy growth of grass.

(2) The suppression in the smaller blanks, by the quick growing coppice shoots.

(3) The resultant crop is not of even growth.

It is obvious that in most cases some form of artificial regeneration will have to be resorted to in order to make the new crop a full one. Accordingly the following procedure may, I think, be given a trial, or something at any rate on these lines.

Ten years before the area is to be clear felled it should be gone over carefully and wherever the cover is too dense or wherever there are natural seedlings on the ground the overhead cover should be opened out. These fellings should be in the nature of

light preparatory fellings. During the next four years cleanings of inferior species should be made every year and every effort made to establish existing young natural regeneration and encourage fresh regeneration.

In the fifth year before the felling, blanks and places, in which it is not expected that a full crop will be obtained from coppice, should be planted or sown up. Such artificial regeneration would then receive annual tending as may be necessary until the time for clear felling arrived. In this way it is hoped that the root system would be properly developed and that when the area came to be felled over these plants would grow up more or less evenly with the coppice shoots. Also by planting and sowing in this way before the felling much expense would be saved, for the growth of grass and weeds inside the forest, even in blanks, before the felling, is far less than that in the clear felled areas.

To sum up again, the advantages of sowing and planting before the fellings are :—

(1) The root systems of the artificial regeneration would have some time to develop and the plants may be expected to be able to compete in growth with the coppice.

(2) Owing to the growth of grass and weeds being very much less inside the forest, the difficulty and expense of cleaning and tending would be much less.

(3) The new crop would be more even grown.

It is not yet known how long it will take before the plants will begin to develop appreciably in height growth and five years may be too short a period, but it is certainly worth trying experimentally.

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GORAKHPUR.

OFFICE REFORM.

Mr. Oliphant, in an article on office reform in the *Indian Forester* of April 1919, stated that a carefully worked out scheme of classification of correspondence introduced into his circle in place of an antiquated system of filing reduced his clerical establishment to a state of gibbering dementia. I have endured a similar ordeal, having been in one circle for a period of three years during which four systems were in force. The first system may have been an extremely bad one and it is probable—although I cannot give an unbiassed opinion—that each of the following systems was a decided improvement on the one which it replaced, but instead of facilitating easy reference, the result of these reforms was to create more and more confusion, until finally it was almost impossible to find the simplest reference. This experience convinced me that the weakness of our classification of correspondence is its liability to change. As a rule the standard of classification of revenue and expenditure in most offices is very fair, whereas that of correspondence is decidedly low, and even in some cases deplorably bad, and I think this difference in efficiency may be attributed partly to the fact that the system is in the former case a permanent one and partly that the same system is in force throughout the province. In many ways it is an archaic system. For instance, it is impossible to classify separately our two main sources of revenue, namely, that received from lessees and that derived from the issue of licenses, but I doubt whether even the keenest advocate of devolution of powers would wish to make it possible for the sub-heads to be continually changed.

It is of great advantage to have one uniform system throughout the province so that when one is transferred to another division or circle one is not obliged to learn a new system, and while regarding reform with a certain amount of suspicion, I should not be unwilling to have the system of classification of correspondence overhauled by a small committee of D. F. O.'s with a Conservator as chairman, for the purpose of prescribing a uniform system throughout the province, provided it were guaranteed that

any system adopted would be permanent and safe from further change. The system I should prefer is one modelled on the system of classification of revenue and expenditure. I would divide all correspondence into files (corresponding with budget heads) which could be denoted by a letter suggestive of the group of subjects dealt with. Thus A for Accounts, B for Buildings, C for Communications, etc. I would then divide each file into a reasonable number of permanent cases (corresponding with budget sub-heads) to each of which would be given a serial number; and to avoid complication, a point the importance of which is not sufficiently realized by reformers, I would not allow the classification to be taken any further. A case is usually taken to mean a collection of papers to which the correspondence clerk allots a separate case cover, but under the proposed system a case would consist of the papers relating to a definite subject. In order to obtain a uniform system throughout the provinces, it would be necessary to adopt what may be considered somewhat vague and general cases. Thus whereas it is the present practice to open a case for every new rest-house built or proposal for reservation, it would be necessary to adopt general cases, such as 'Construction of new Rest-houses' or 'Proposals for Reservation.' Many people have a love of detail, and if it were permissible further to divide the budget sub-heads, it is probable that, for instance, the revenue from bamboos would be classified in further detail to show the reserve or range from which it was derived. The fact that further classification is not permitted does not, I think, cause serious inconvenience. It is, however, not only permissible, but the usual practice, to adopt a certain amount of method in the arrangement of items under a given sub-head. Thus the items under A-IIa are always arranged in the following order, teak timber, reserved timber, and unreserved timbers. In the case of correspondence, without allowing the classification to be taken beyond the case, I would not only authorise, but definitely prescribe that the papers in any case should be arranged into convenient bundles, each of which would be given a different cover. Thus in the case 'Construction of new Rest-houses,' I would open a new bundle for each new rest-house, so that in this case there

would be as many bundles as there were rest-houses in the division. Similary in the case 'Personal records of subordinates of the Executive Establishment' there would be as many bundles in this case as there were subordinates. In the case 'Repairs to Forest Rest-houses,' I would, as soon as the annual report had been written up, send the whole bundle of papers in this case to the record room and open a new bundle so that in this case there would be a bundle for every year.

Under this system it would, I think, be much easier to trace any reference than at present. Instead of starting a new register of cases every year which means that the case numbers are changed every year, there would be a printed index of files and cases from which one could find out where the papers on any given subject would be stored in the record room. The almirah behind the table of the correspondence clerk and the shelves of the record room would be divided into as many partitions as there were files prescribed. The partition would contain a number of cases arranged according to their serial numbers. Any given case might comprise a number of bundles, but all the bundles of, say, case B.10 would be found sandwidged in between case B.9 and case B.11. The bundles would be arranged in chronological order so that even a clerk with no special experience should be able to consult the index and find any paper required.

A further advantage of this system would be that the Conservator's office would be able to exercise a general supervision over the classification of correspondence by clerks in divisional offices. Thus if a divisional clerk registered a letter as 2159/P-13 when the correct file letter and case number should have been/R-29 the Conservator's correspondence clerk, when despatching the reply, could underline the file letter and case number with red ink to indicate that a mistake had been made. In the case of letters on original subjects received from the Conservator the clerk would simply adopt the classification given.

"PEDESTRIAN."

1st June 1919.

TREATMENT OF TEAK FORESTS IN THE C. P.

The teak forests of the Central Provinces were reserved during the period 1860—1880. Treated at first unscientifically, methods have gradually been systematized until now most of the forests are worked under regular systematic Working Plans. Briefly these Working Plans prescribe coppice with standards or improvement fellings according as it was considered that the forests would eventually be worked as coppice or high forest. It is with the latter that this note deals.

The teak forests of better quality which it is desired to work as high forest consist of a mixture of teak with other species of less value. The quantity of teak varies from almost pure teak to a forest of mixed species with only occasional teak trees. The stock is very dense in places, very open in others and there are numerous blanks. The age classes are mixed up, and mature, middle aged and young trees are frequently found together. The treatment by improvement fellings aims at the eventual management of these forests as selection forest and are admirably suited to this purpose. The Working Plans divide the areas up into 20 or 30 coupes in each felling series and prescribe the working of one coupe annually. All dead, dying, malformed and otherwise unsuitable teak trees are to be removed and to be replaced by coppice or seedling growth. The work is usually done well. After the improvement fellings, which include departmental cutting back operations, coupes receive no attention whatever except that in a very few Working Plans climber cutting is prescribed every five or ten years. A forester's most important work—regeneration—is practically ignored in the Working Plans. While on tour Divisional Forest Officers usually have a look to see how it is getting on but nothing is done to help it, except that occasionally established regeneration is helped in the departmental cutting back operations by removing overhead cover.

The selection system of management is now generally admitted to be obsolete. If we accept this, and agree that the ultimate treatment will be one of the regular systems with

concentrated regeneration and concentrated fellings then our system of improvement fellings is also obsolete. The Working Plans Officer of the future will be faced with the problem of converting a forest which has been managed for 40—60 years with the object of getting the age-classes distributed throughout the area, into a forest in which the age-classes are in even aged blocks. The following descriptions of a well-known forest in Berar at different periods of its existence and a forecast of the condition of the crop at the end of the present series of improvement fellings illustrate well the problem this officer will have to face.

The following description was written in the Working Plan of 1895 which regulated the working of the forests from 1895 to 1915 :—

" The present condition of the crop of the Bairagarh Forest which has enjoyed twenty to twenty-five years of protection from fire and grazing may be generalized as follows :—

There is first the old growth of ante-protection days injured by pollarding, lopping, shifting cultivation, forest fires, injuries from cattle, and every conceivable abuse ; most of the constituents of this category are naturally unsound and misshapen. Next, and mixed with the above, we have a sprinkling of poles whose age is somewhat longer than the period of protection, and the result of seedling or young coppice shoots, which formed an irregular and scanty advance growth when protection began. Lastly, the present seedling and advance growth produced from the seed of the more vigorous of the old ante-protection stock, and which has been coming up gradually faster and faster since the surface of the soil has been brought by protection into fit conditions for the support of tree plant life."

The following description is taken from the present sanctioned Working Plan written in 1915 :—

" The old growth of ante-protection days has been largely replaced by coppice shoots, the results of improvement fellings, especially in the later coupes where exploitation has been more thorough. The sprinkling of teak poles mentioned as constituting an advance growth when protection began has now

reached middle age or is approaching maturity and will give the first yield when final fellings are introduced. The younger growth of teak now consists of coppice, and seedlings of all ages, the latter predominating."

From the above two descriptions the condition of the crop in coupes number 1 worked in 1895-96 and again in 1915-16 under Improvement Fellings as it will be in 1935 when the plan comes up for revision can be fairly forecasted as follows :—

All the misshapen and unsound old trees will have been removed. There will be a very few old well-shaped trees which were of timber size in 1864 when the forest was reserved. Their age will be say 90 years upwards. There will be a number of trees which were young saplings and seedlings when the forests were reserved. Their age will be 70 to 90 years. There will be the crop which sprang up immediately on the introduction of reservation and protection. Age 60—70 years. The Improvement Fellings of 1895-96 will have produced coppice aged 40 years and the Improvement Fellings of 1915-16 will have produced coppice aged 20 years. All these age classes will be thoroughly mixed in the coupe, conditions ideal for the introduction of selection fellings, but presenting serious difficulties to the Working Plans Officer who is called upon to find a system by which concentration of age classes and concentrated regeneration may be obtained.

The problem that would face the Working Plan Officer now is, of course, no less difficult. The suggestion is, why not introduce concentrated regeneration as soon as possible. The only answer can be because we do not know how to do it. We should, therefore, start experiments on a large scale in every division in which the teak is considered good enough for high forest. The note, dated 23rd March 1918, of the Inspector-General's tour in Burma, shows us that one province has tackled the problem successfully. Our experiments might start on the lines there indicated. The rotation at first will have to be fixed more or less arbitrarily, but we have some data to go on. The Hon'ble Mr. J. W. Best in his article in the *Indian Forester* for September 1918 comes to the conclusion that 60 years is a suitable rotation for teak forests in two ranges of

Hoshangabad Division and the experience of most forest officers in the Central Provinces will probably lead them to agree with him.

It is not suggested that the whole of our better quality teak forests should be lumped into a high forest working circle. There are many areas where the conditions are peculiar and the selection system may have to be retained. Examples are steep slopes where heavy felling would be likely to expose the soil to erosion ; frost hollows ; areas, where bamboos predominate and which can more profitably be worked as bamboo forest with a teak overwood.

Assuming that our policy is to introduce a regular system and we accept some such rotation as 60 years, a method would have to be devised to convert the forest into a more or less regular series of age classes. The case of Bairagarh Reserve mentioned above is in many ways not typical, but was cited as an example showing what our present system would lead to. I believe I am right in saying that no other teak forest has been completely worked over by improvement fellings and in no other forest will the age classes be found to be so mixed as they are in Bairagarh. The Working Plan Officer would have to stock-map his forest first and exclude areas which are of poor quality to be worked as coppice and other areas for special reasons. The area to be worked as high forest would be split into periodic blocks. Three would be ample at first with a sixty years' rotation. The working plan would prescribe regeneration of one block and into this the Working Plan Officer would be expected to place the compartments containing the greater number of mature trees. He might also include areas containing large quantities of established regeneration and by removing the overwood and replacing it by coppice, call the area regenerated. The effect of this would be to reduce the time required to regenerate the first periodic block. To the second and third periodic blocks would be allotted areas containing the greater number of older and younger immature trees and they would be treated during the first period to a series of fellings, the object of which would be to favour the growth of that part of the growing stock which is most nearly the age that the periodic

block in question is supposed to represent. Thus if block I is under regeneration, block II would contain those areas in which trees from 10 to 30 years old predominate and the fellings in this block would tend to favour trees of this age. Similarly the fellings in block III would tend to favour trees of 30—50 years of age.

It is unnecessary in this short note to discuss the advantages of concentrated regeneration methods over the selection system of management. The question has been thrashed out in Burma and the decision seems to be all in favour of the more regular method. The whole object of this note is to emphasize the fact that if we are going to scrap the selection system we should also scrap improvement fellings, and introduce regular methods at once.

Teak is by far the most important timber tree in the Central Provinces and yet our knowledge of its sylviculture is almost *nil*. The better class teak forests of the province could be divided into classes by soil, growing stock, locality, etc., and in each class, in each division, experiments on a large scale should be commenced to determine how it can best be regenerated. In Burma they seem to be regenerating teak as pure forest. Many forest officers of this province hold the opinion that it should be grown mixed with other species. We have to determine the proportion of teak and modify our methods to obtain it. The species to be encouraged in these mixed teak forests have to be selected and the value of fire as a help to regeneration must be investigated. The real value of fire-protection has also to be determined. There is considerable doubt as to its necessity in established forests past the regeneration stage. The Central Provinces spends over a lakh annually on fire-protection and under half a lakh on works of improvement (A. VIII, g). At first we shall probably have to accept coppice shoots as regeneration but as our knowledge of the sylviculture of teak increases we may be able to dispense with it. As yet we do not know definitely that seedling teak produces a better tree than a coppice shoot.

The object of this note is, in short, to urge that the method of managing our teak should be discussed and decided. If the decision is in favour of concentrated regeneration, then let us start

as soon as possible. If the decision is for the selection system let us at any rate do it scientifically and determine our rotation and the possibility of our forests. The continuance of improvement fellings as they are now carried out is little more than a confession of ignorance.

C. M. HARLOW, I.F.S.

30*th May* 1919.

LIST NO. 1.

PLANTS USED AS INGREDIENTS IN THE MANUFACTURE OF COUNTRY SPIRITS IN SONTHAL PARGANAS.

No.	Local name (Sonthali).	Scientific name.	REMARKS.
1	Chaulia	*Ruellia suffruticosa*	An essential ingredient.
2	Damka-dura	Not identified	Ditto.
3	Ralli	*Piper longum*	...
4	Manjur Chuli	*Elephantopus scaber*	Used in Sambalpur also.
5	Saram-lutur	*Clerodendron seratum*	...
6	Tejo-mala	*Cissampelos Pareira*	...
7	Lilkathi	*Polygala crotalarioides*	...
8	Hat	*Holarrhena antidysenterica*	Used in Sambalpur also.
9	Goti	*Croton oblongifolius*	...
10	Hutar	*Indigofera arborea (pulchella)*	...
11	Kawet	*Abrus precatorius*	...
12	Kia-baha	*Pandanus fascicularis*	Used also in Sambalpur.
13	Atkuti	*Echinops echinatus*	...
14	Kalmeg	*Andrographis paniculata*	...
15	Kargali	*Cleistanthus collinus* or *Lebidieropris orbicularis*	... Used in Sambalpur also.
16	Kedar Nari	*Asparagus racemosus*	Ditto.
17	Dimboo baha	*Ocimum Purpurescens*	...

No.	Local name (Sonthali).	Scientific name.	Remarks.
18	Badgocha	Probably a species of *Vernonia*	...
19	Atkir	*Smilax macrophylla*	Used in Sambalpur also.
20	Karla-da	*Momordica Charantia*	...
21	Kolo	*Dioscorea dæmona*	Used in Sambalpur also.
22	Matkom chal	*Bassia latifolia*	Bark only used.
23	Sarjom chal	*Shorea robusta*	Bark only used.

List No. 2.

Plants used as ingredients in the manufacture of country spirits in Sambalpur, that are found in the Sonthal Parganas but not used here.

No.	Local name (Sonthali).	Scientific name.	Remarks.
1	Per camra	*Helicteres Isora*	...
2	Juar	*Andropogon Sorghum*	...
3	Barangom	*Vernonia cinerea*	...
4	Bhernda	*Jatropha Curcas*	...

Note.—The roots of all these plants are used except Nos. 21 and 22 in which case it is the bark.

J. P. Haslett,
Divisional Forest Officer,
Sonthal Parganas Division.

14th May 1919.

Note on "Ranoo."

Its composition, preparation and use in the Manufacture of Country Spirits.

Ranoo.—Is a preparation made from the roots of two or more of the plants mentioned in the list of the plants used as ingredients in the manufacture of spirits, combined with various spices and the flour of rice, or the marua.

2. *Preparation.*—The roots of the first two plants named in the list are essential for its preparation, *viz.*, "Chaulia" and "Damka-dura," those of any of the others may be added.

The roots are washed and ground in water, together with the following spices and flour:—

(1) Pepper corns.
(2) Cumin seed (Jira).
(3) Cardamoms (Ilachi).
(4) Ajwain (Carum copticum).
(5) Rice flour.

In the proportion of—

10 seers rice flour.
¼ seer roots of "chaulia" plant.
¼ „ „ „ "Damka-dura."
1 tola each of the roots of any of the other plants except of "Kolo" and "Kargali" which are poisonous, the smallest bit therefore being used of the two latter.

3. This mixture having been prepared, it is made into little round hard pellets the size of a marble.

4. *Uses.*—These round pellets go by the name of "Ranoo," and are used to bring about fermentation in the manufacture of rice beer.

5. Country spirits are made in the usual way by the process of boiling rice or other grains, two of these pellets of "Ranoo" being added for every 1½ seer of rice, and the mixture allowed to stand in a jar from four to six days to allow it to ferment, when it is fit to drink.

J. P. HASLETT,
Divisional Forest Officer,
Sonthal Parganas Division.

14th May 1919.

PRIZE-DAY AT THE MADRAS FOREST COLLEGE.

On the 30th June this function was most successfully celebrated at the College, before the largest audience that has yet graced such occasions. In fact the house was full, long before the advertised hour and many had to stand or sit in the corridor outside "Gamble." It is understood that it is under contemplation to hold the gathering in future in the Gass Museum. The President of the Board of Visitors Mr. S. Cox, Chief Conservator of Forests, was supported on the platform by the members of the Board of Visitors (the four Conservators of the Presidency), the Principal, the College Staff and the Examiners.

Two students obtained Honours, 20 the Madras Ranger Higher Certificates and 6 the Madras Ranger Lower Certificates.

The prize-winners were—

Campbell-Walker Gold Medal ...	B. S Chengappa.
Brasier Gold Medal	Abdul Hamid.
Honours	T. D. Ponniah.
	P. Sankunni Menon.
Gold Medal for the highest senior student	T. D. Ponniah.
Board of Visitors' Gold Medal for the highest junior student ...	G. Appa Rao.
Lodge Gold Medal for Engineering ...	T. D. Ponniah.
Forestry Prize	T. D. Ponniah,
Survey Prize	P. Sankunni Menon.
Range Administration Prize ...	T. D. Ponniah.
Botany Prize	C. R. Regunathan.
Indian Forester Gold Medal for past students	L. J. Taylor.
Indian Forester Gold Medal for present students	E. S. Wambeck.
Pentland Challenge Shield	C. B. Chengappa.
Fischer Prize for Gymnastics ...	D. Venkateswaralu.

In the course of his opening speech the Principal remarked:—'To-day is an historic occasion in the annals of the Forest Department of Madras—for our annual prize giving is presided over for the first time by an officer of our service—the Chief Conservator, the Head of the Department. Since I entered the service nearly 28 years ago there has been no such momentous occurrence as Mr. Cox's appointment—not even the starting of the Forest College seven years ago—and it is up to all of us including you, students, by loyal and devoted service to justify the step that places us on an equality with the other great Forest Provinces of India. I think, Sir, you may rely with confidence on the College to serve you faithfully and to the best of its ability.

"The new era is again fortunate in its inception by the decision of His Excellency the Governor to assume the Forest Portfolio."

* * * * *

"Thanks to the greatly increased facilities now afforded in the Demonstration Forest, the Engineering Park (the apparatus of which has been so effectively extended by Mr. Crothers, the Senior Engineering Instructor), the Arboretum, and the Sylvicultural models in the Museum, the students during Head-quarter terms spend at least six hours per week in field work, *i.e.*, more than double the time previously possible. From the lecture room they are now able to go straight to the field and apply (or at least to be tested in) the theories they are by way of having imbibed. Freehand Drawing—a valuable accomplishment for a Forest Officer—has been encouraged on tour, and I also invite your attention to the Engineering drawings (the work of the students): they are hung round this room. A student's drawings at the end of his course are now bound and sent to him. They form a more or less edifying record of his progress in this branch of the College course. But a drawing of very exceptional merit may be retained and framed as a permanent adornment to the walls of the College. This privilege is jealously accorded and I hope proportionately appreciated.

"The students' gardens, fuel depôt, provision stores, badminton courts, and improved tennis courts, athletic ground and

pavilion are innovations since last year that tend to render a sojourn more comfortable, sociable and healthy. The Government have given a generous contribution to the Students' Club and a considerable number of officers and of old students have already forwarded me subscriptions. If we get an adequate response I hope to have the work started within six weeks.

* * * * *

"As regards the estate we are at great expense forming an ornamental park round the College and by increasing the roads and paths, and by extending the borders and avenues we are endeavouring to convert a wilderness or a morass (according to the season of the year) into a habitable and pleasing property. But we can make no proper progress until we are provided with an adequate water-supply—my feelings on the subject do not permit me to enlarge on this painful topic."

* * * * *

"The athletic side of the College has maintained its average standard and has had a fair share of success. We *ought* to have won the Final of the Stanes ? Hockey Cup. That we did not was due to the lamentable fact that on the day we didn't play well enough. We undoubtedly suffer from lack of expert coaching.

"The tennis courts are still not very good, but there is a lot of fun to be got out of them, and I hope that with the future support of *every* member of the staff the Tennis and Athletic Club will enter on a new epoch of prosperity."

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"The Senior Division, as a whole, is rather below the average this year ; but there are no failures and no one anywhere near failing."

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"And now students I have one or two things to say to you. By Mr. Dawson's departure next month you are losing a very good friend and a devoted and loyal colleague. For five years he has given the best of his ability and energy and much of his leisure to your interests and to your welfare, and he has been responsible for many of the improvements to your comfort and

condition here. I do not remember his ever having been absent from duty while I have been Principal, but I do not remember that he seldom came into my room in times of more or less pressure without some scheme for your moral or material advantage. I have always tried to see his point of view and when I have not been able to accept it you may have thereby suffered loss, but the responsibility for the disability was mine—it was not due to Mr. Dawson's lack of eloquence on your behalf. You will, I know, join with me in wishing him good health and a happy life in his retirement. You may be sure that his thoughts in the future will be constantly with us here and with those of you who have shown yourselves responsible to his advice.

"In this matter of responsiveness to your environment of which I spoke to you last year I am glad to note a distinct improvement in the spirit of the College, as exemplified by your subscription of Rs. 5,100 to the War Loan, by your efforts to work up your gardens, to write for the Magazine, to compete for the Indian Forester Prize and generally to play up to the stimulus. Then again the excellent gymnastic show you put up on Saturday was an agreeable revelation to many of us. But don't go away with the impression that you are archangels, you are far from that, although I believe that you are every one of you better fitted to become good citizens of the Empire than when you joined here: the Empire that within the last 48 hours has imposed the terms of a victorious peace on its unscrupulous foe. And yet what I dread most is that after you have left the College you may become a prey to your surroundings and may forget the one lesson that we have tried to teach you here—*i.e.* to do your bit. It is not doing your bit when I am told by a conservator or a district forest officer that such and such a man states that he cannot carry out a certain irksome job because he was never taught it at the College, when we here *know* that he has actually practised in that very task or in its own twin brother. It is not doing your bit to fail in range charge, or to spoil a fine engineering project from the College by bad execution, or because you happen at the College to have been trained into a

good athlete to neglect your professional duties for recreations. If it not had been for the defection and culpable laxity of a past student, who had a distinguished career here, we would by now have had the students' club nearly finished. It is just this subsequent failure of some of our most brilliant students that fills me with poignant regret and makes me very chary in recommending honours or certificates in doubtful cases.

"We learn most from our own failures, and although the man that never makes mistakes never makes anything, that is no reason for making the same mistake twice.

"To their discredit there are three students in the College who are still unable to swim. One of them is a junior. I hope the house committee during the next touring season will complete his education in that accomplishment.

"On the whole the College reputation for endeavour is, I am glad to say, high and rising higher. It was very gratifying to receive not long ago an enquiry from the Inspector-General of Forests as to whether we could supply two men for the Andaman Forest Department at a high salary. Unfortunately at present we have no private students, the only category available for such appointment—but the request was none the less pleasant hearing. Although it is not a very fashionable word just now I am proud to think that Efficiency (with a capital E) is still our ideal—and perhaps we may define Efficiency as the practice of doing to-day what we could much rather put off till to-morrow, or "the meeting of difficulties with square shoulders" as one of you put it the other night at your very cheering entertainment which some of us had the privilege of attending.

"Students, the College does a good deal for you and I would ask you to do something for the College. You probably have very little idea of the amount of solid work Mr. Crothers as house tutor has put in with the object of ensuring your comfort and welfare. With less efficient supervision I should be sorry to think of what his agents would make of your roads, your hotels and kitchens. To give some return after you have left the College will not be very difficult. Send us contributions in kind for the

museum ; remember that the students' club can only be built by cash and not by promises ; write for the magazine, and those of you who are range officers, in the college camps, do your best to make us comfortable. Never forget the dignity of manual labour ; you ought to know something about it by this time. Try and carry on the excellent system of ryots' conferences initiated by Mr. Dawson. You will in future be the liaison officers between the forests and the people—and it is by propaganda work that you can best serve your commander-in-chief and his head-quarters staff. Above all remember that the name of the College rests with you and that your good work must be the basis of its reputation. I need hardly say how glad we shall always be to welcome you here. We are delighted to see the faces of so many old students to-day. It is perhaps primarily for the past students that we propose to give every year the garden party, from which this long sermon is detaining you. But I have had 28 years of making mistakes and I want to help you to avoid them as far as possible.

"Students I wish you God speed."

The President then replied in the following moving terms :—

Mr. Cowley-Brown, Ladies and Gentlemen,

"It is a great regret to all of us that His Excellency the Governor is unable to be present to-day as he would have been had it not been for the Bellary tour. However it is but a pleasure deferred and Lord Willingdon will not only be here for the College Athletic Meeting in September but I hope will spend two or three days at the College and see the students at their work. We will look forward to giving him a very hearty welcome.

"Turning now to Mr. Cowley-Brown's report I have to congratulate him once more on behalf of the Board of Visitors on his most capable and sympathetic management of the College. His enthusiasm is infectious and the Board is glad to see how well it is reflected in the general smartness and keenness of the students.

"I may add that the Board is specially impressed with the very great improvements that have been made to the forest estate. Much of the work has been done by the students themselves

and a great deal of credit is due to the present Estate Overseer Mr. Ramaswamy.

"There are still urgent wants. The question of the water-supply is a very serious one and must be tackled at once. Mr. Hart has very kindly met the Board of Visitors and the Principal during the past week and discussed the whole subject. As a result I think we can reasonably expect to have an efficient scheme of supply sanctioned by Government and put into operation within the next two or three months. Then we badly want a Students' Club and I echo all the Principal has said in his appeal for subscriptions. I should also like to see a pavilion more worthy of the College. And the tennis courts require sheltering from the gentle breezes of Coimbatore such as we are now experiencing. Play on a day like this is rendered impossible unless some protection is provided.

"In the matter of educational standard the Board of Visitors is of opinion that the College is at present somewhat below the average; but on the other hand the Principal has been able to certify that he has never had a body of students under him which has exhibited so much keenness to learn or which has been so admirably steady and disciplined in their conduct. That is a fact on which the Board desires to congratulate the whole College, and it considers that Mr. Crothers has been in this matter of valued support and assistance to the Principal.

"With regard to 'Athletics' there have been successes and failures; the College teams are handicapped by their long absences on tour. I should like to see the College win all its games. Perhaps you may think this an impossible ideal, but with Mr. Cornwell to coach you I hope you may go very near it next year.

"Mr. Cowley-Brown has not I think referred in his report, which of course deals with the past year, to a matter of considerable future interest to the College. By arrangement with the Government of India and with Provincial Governments, we are going to train in future considerable numbers of Government students from Bombay, Central Provinces, Bihar and Orissa.

"It is our business to return these students not only well qualified for their future careers and a credit to the training at this College, that is a matter chiefly for the Staff; but also to send them back with the pleasantest recollections of their life at this College—that is a matter chiefly in the hands of you students.

"I hope you will extend to those men your hospitality and good-will and thereby increase the prestige and reputation of your own College throughout the whole of India.

"I think some of those present will desire to hear some details of a subject, which must often have been in your minds—*i e*, the Reorganisation of the Subordinate Forest Service. The matter stands like this. Government have sanctioned the scheme to take effect during the current financial year and has allotted one lakh of rupees for that purpose. The total cost of the scheme is of course considerably more, but for want of trained men it is not possible to introduce the whole scheme at once. The Conservators and I have been working at the details for some time past—it is a complicated business—but we hope that by the 1st of October the scheme may be in force. Practically the whole of this year's allotment will go to the increase of pay of those now serving and I trust that will meet with your approval. All of us are delighted that the long promised improvement in the pay and prospects of the subordinate service has come at last.

"And now I should like to turn for a minute to more general subjects. Mr. Cowley-Brown has referred to the fact that for the first time in the history of the Madras Forest Department there is a forest officer at its head and has assured me, as that officer of the cordial support of the College. Knowing Mr. Cowley-Brown as I have done for many years, I have never been in a moment's doubt of such support, but I am not the less grateful for the assurance. But in the few remarks which follow I want to take an entirely impersonal stand-point.

"The appointment of the Chief Conservator is the last step in a reform which has been in progress for a long time; whereby the technical management of this vast property of 20,000 square miles

of forest has gradually passed out of the hands of the Civil Service into that of the Forest Service.

"Previous steps have been, as most of you know, an alteration in the relations of the collector and the district forest officer and a considerable increase in the latter's authority. The conservators' powers have also been considerably increased and may, I hope, be further increased in the future. But the reform goes a good way further back than that. I remember that when I and some of those present to-day first came out to India, the position of the district forest officer was little better so far as the authority of his office was concerned than a head clerk. He was undoubtedly viewed with great suspicion by Government. The conservator then was merely an advising officer whose advice was as often ignored as accepted. That is all ancient history and I only mention it to show how far we have since progressed.

"With this latest development I think we may say that the Madras Forest Department now stands on its own legs and I think it is a position on which we may legitimately congratulate ourselves. It shows at least that we have acquired the confidence of Government.

"But it is also a position which has its own responsibilities and its own risks and I regret to have to say that we have still to acquire the confidence of the public.

"The position of the department in relation to the ordinary villager always seems to me to be much that of a schoolmaster to a schoolboy. The master imposes on the boy a number of rules and regulations which he intensely dislikes, and when doing so he tells the boy not only that it is for his good but that he will be very grateful for it when he reaches years of discretion. The boy does not believe a word of it; nor does the villager; and that is where our difficulty lies. The difficulty is moreover enhanced by the very long period which the villager will take to reach that of understanding maturity which I spoke of. It is a matter of time and patience and a great deal of both.

"But with educated classes the position ought to be quite different, but there we are up against the fact that we are very

much out of touch with them. The educated classes either view the department with indifference in dealing with so remote an interest as forestry or when we do come into contact with them they are inclined to regard our motives with some suspicion.

"Want of sympathy for the poorer classes and a greed for revenue are often urged against us.

"Well, I do not propose to argue the points or to attempt a defence of the department on this occasion, what I am interested in and wish strongly to emphasize is the necessity of making our achievements and aims better understood and by doing so remove some of the suspicion which clings to our motives. No doubt this is a difficult business but opportunities will occur if we look for them.

"Take the case of working plans. I see no reason why, when we are preparing working plans and especially those which deal with the supply of small timber and fuel or with grazing, we should not call into council the educated opinion of the laity. We should place all the facts we have at their disposal, lay all we can do on the table, explain the difficulties and invite suggestion. No doubt we should not always get agreement; but we may get understanding and it is on understanding that confidence is acquired.

"I mentioned working plans and Mr. Cowley-Brown has referred to the admirable system of informal discussions with the local people introduced by Mr. Dawson into the camp routine of the students.

"Other opportunities I am sure can also be found if we look for them.

"It must be remembered in these democratic days that it is not sufficient to know that one is in the right—one has to convince the other man of the fact.

"So much for one of our responsibilities; now for one of the risks. The risk I am most anxious to remove is one referred to by Mr. Couchman at last year's prize giving. The risk that under the new constitution the forest department may become self-

centered, may try and plough a lonely furrow and may lose touch with the general district administration.

"That I think would be one of the greatest misfortunes that could happen. We must remember that we are only a part of the great machine of Government and must harmonize our movements with the rest of the machinery.

"Besides looking back on the past and especially the last ten years during which the department has made great progress, I think one must be blind and ungrateful not to realize how much of our success has been due to the Civil Service and especially to collectors by whose sympathy and co-operation we have turned many awkward corners.

"I am very glad to have the opportunity as head of the department and a forest officer of acknowledging our indebtedness to the Civil Service and know that I voice the general feeling of the whole service. Their co-operation in the future is more necessary to us than in the past and we must do all we can to retain it.

"Some of you know the special paragraph in the district forest annual administration reports entitled 'Relations of Forest Officers with Revenue Officials' or words to that effect. For many years past the only remarks I remember are 'satisfactory,' or 'cordial' or 'very cordial.' Unless Government, bored with the constant reiteration, decides to cut the paragraph out of future reports, I hope we may not in our time break this record for monotony.

"One more word before I sit down. When the College meets again in August the familiar face of Mr. Dawson will be absent, as Mr. Cowley-Brown has informed you. I want on behalf of this large meeting of forest officers of all ranks to assure him of our very best wishes and hope that he may long live to enjoy his retirement from active service.

"And now I think Mr. Principal, we may turn to the really important business of this meeting—the Prize Giving."

On the conclusion of the chief conservator's speech the Principal requested Mrs. Cox to honour the College by presenting the prizes to the successful students.

The company then proceeded to the ornamental park that is being formed round the College and to the strains of the Band of the Malabar Rifles partook of the hospitality of the Board of Visitors and the College Staff. A feature of the afternoon was a ceremonial dance by the Coorg students. Many old students were present, and the evening was devoted to informal reunions and social gatherings till far into the night.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester*.

TIGER SHOOTING

SIR,

Reference "Kai Htun's" letter under the above heading published in the June number of your Journal: it is a pity "Kai Htun" did not wait till he was better, before rushing into print, as then it is probable he might have had something useful to tell us; from his present letter one learns very little. However, to reply to it in detail; "Kai Htun" condemns my action in persisting in exposing unarmed men to danger a second time after the experience of the morning. Firstly, they were not altogether unarmed, as they were led by a man of their own choosing, who carried one of my guns, and was said to be a very good shot. Also I was out again in the evening, not by any wish of mine, but at the pressing request of these very same Gurkha squatters. The wounded tigress was lying up in a patch of jungle, not 50 yards from the road, along which these men were in the habit of taking their milk into town between 3 and 4 a.m. every morning; and it was they who pressed me to go out again in the evening as they did not like the idea of having to pass so close to the beast, at that hour of the morning. My own intention was to wait till next morning, in the hope that the buffaloes I had sent for from a village some ten miles away would have had time to arrive.

Apropos "Kai Htun's" remark about the use of dogs for tracking wounded tigers, would he let me know the breed of dogs one would have to employ in such a case? I have heard of panthers being followed and killed with the aid of dogs, but never tigers. In the present instance, when I went out the second time, I took with me a pack of village "pies," headed by two terriers of my own, plucky little fellows, who have stood up to bear and pig more than once, but no sooner were we in the vicinity of the tigress and her fresh tracks were found, then there was a general stampede of the canine pack for the village, and my terriers were not last.

G. M. 1.

ESTABLISHING TEAK IN AN AREA OF MIXED JUNGLE SPECIES.

SIR,

Last year I undertook an experiment with a view to establishing teak in an area of mixed jungle species. The coupe selected had just been exploited under the Coppice-with-Standards system of management.

2. The most desirable results were the elimination of nearly all useless inferior species, the weeding of the entire area and the complete aeration of the soil, all of which tended towards the firm establishment of the young teak plants put out.

3. I took great interest in the work and am sending you a short description of it in the hope that it may prove interesting.

"It has always been a firm belief locally that hill crops, *i.e.*, Nachni also called Raggi (catch crops) cannot under any circumstances be raised without firing the area proposed to be cultivated. This conviction I could not share especially in cases where the soil is rich in humus and therefore undertook an experiment designed in the first instance to establish teak in an area devoid of that species and incidentally to put my opinion to the test. When the proposal to grow a hill-crop without firing was first mooted, it was met not only with incredulity but derision.

"The interest and service of two trustworthy forest contractors were enlisted and they were prevailed upon to help me through, as I found it practically impossible to do the work departmentally.

"Both these men responded and undertook the growth of Raggi in a recently felled coupe without firing the area, which was cleared of all litter by villagers. At the end of May 1918 they set about grubbing up the stumps of the useless species and digging out the large stones which helped to loosen the soil considerably.

"With the onset of the rains in June Raggi was sown, but owing to a defective monsoon the crop was not as good as was expected. Simultaneously with the sprouting up of Raggi, teak seedlings from the forest nursery, near by, were planted out, 4 ft. by 4 ft. To husband the Raggi crop to maturity, several weedings were necessary and by the execution of this part of the work, the teak plants were materially assisted in establishing themselves.

"The contractors were paid nothing in cash; they merely took the Raggi crop in return for cleaning the area, planting out teak and the subsequent weedings.

"Nearly 60 out of every 100 seedlings put out are doing well, whereas out of the remaining 40 several are found throwing out shoots after the original plant had died off to the ground level."

4. The experiment is being tried this year in connection with the eradication of Lantana and in the introduction of teak in the mixed forests of the State. Success in this direction, it seems to me, will link the people to the Forest Department more firmly than any other measure.

SAVANTVADI: W. E. PEREIRA,
May 1919. *Chief Forest Officer, Savantvadi.*

["Our contributor has not explained the reason for not following the usual practice of burning all the refuse on the ground prior to the introduction of the field crop and transplanting the teak. We should be glad to learn his reasons for departing from the usual practice of firing in such circumstances."—HON. ED.]

THE USE OF ATLAS PRESERVATIVE TO KILL TREES.

SIR,

In the *Indian Forester* for January 1919 I note that Mr. A. J. S. Butterwick, P.F.S., has had very poor success with the use of Atlas Preservative for killing trees in Burma, and, as my results are completely opposed to those he obtained, I think some details from this country may be of interest to your readers.

2. In 1916 and 1917 some large Sample Plots were started in Selangor to record the girth and height increments of dominant trees of the more important species, and trees in these plots which were dominating or suppressing the measured trees were deeply ringed.

3. It had been known for some time that many trees, particularly those marked with a * in the list below, either would not die as the result of a light girdling or that their death was not to be expected for some years.

4. In 1918 many of the girdled trees were still alive and apparently perfectly healthy, so having read Mr. C. W. Allan's account of the use of the Atlas Preservative I decided to try it here. In March and April 1918 it was painted on the old girdles but had no immediate effect, so in June I had a fresh cut made just into the sapwood and the preservative painted on ; within a few days the trees started dying. In October 1918 all trees except Nos. 3, 8, 10, 17 and 23 were dead and a further application of the preservative finished off these latter within a month.

5. The death of trees under 3 feet in girth took place within three weeks, while that of larger trees took longer. In the case of some large camphor trees over 10 feet girth no effect was noticed for two months, when suddenly all the leaves turned yellow and started to fall and the trees are now dead. It would appear that Mr. Butterwick's experiments which lasted from 15th July to 10th August did not give the preservative a fair chance.

6. The following list gives the names of the treeswhich were treated and which have died; some had not been girdled in previous years :—

Serial No.	Vernacular (Malay name).	Botanical name.	Remarks.
1	Pendarahan	Myristica spp.	*
2	Jelutong	Dyera ,, ...	*
3	Klat Jambu		
4	,, Merah ...	Eugenia ,, ...	*
5	,, Bukit		
6	Kempas	Koompassia malauensis.	
7	Kedondong ...	Canarium spp.	
8	Chimpoh	{ Dillenia ,, } { Wormia ,, } ...	*
9	Sebasah	Glochidion ,,	
10	Petaling	Ochanostachys amentacea ...	*
11	Sial menaun ...	Pternandra spp. ...	*
12	Merbau	Afzelia palembanica ...	*
13	Rengas	Melanorrhœa spp.	
14	Kumbang Semangko ...	Sterculia ,,	
15	Keranji	Dialium ,,	
16	Taban	Palaquium oblongifolium.	
17	Berumbang	Connariopsis spp.	*
18	Medang Tanah ...	Elæocarpus ,,	
19	Delik	Memecylon ,,	
20	Pisang Pisang ...	Anonaceæ ,,	
21	Rambutan	Nephelium ,,	
22	Penaga	Mesua ferrea.	
23	Putat	Barringtonia sp.	*
24	Tampinis	Sloetia sideroxylon.	
25	Langsat	Lansium spp.	
26	Mempening ...	Quercus ,,	
27	Terap	Artocarpus ,, ...	*
28	Camphor	Dryobalanops aromatica.	
29	Pagar anak	Ixonanthes ,, ...	*
30	Meranti	Shorea spp.	
31	Kepayang	Pangium edule.	
32	Bangkong	Sarcocephalus spp.	
33	Simpoh gajah ...	Dillenia ,,	
34	Parh Kijang ...	Irvingia malayana.	
35	Minyak berok ..	Xanthophyllum spp.	

5th May 1919.

A. SANGER-DAVIES,
Forest Dept., F.M.S.

SIR,

In his article in the *Indian Forester* for January 1919, Mr. A. J. Butterwick appears to think that Mr. C. W. Allan rather over-rated the effectiveness of Atlas Preservative for killing trees. It might perhaps be of interest to your readers to hear of an experiment (based also on Mr. Allan's article) we tried here, which proved entirely successful in this respect.

The forests of Trinidad are of the moist, tropical variety composed of hard and soft-wooded broad-leaves species, some trees of which simply cannot be killed by girdling. The rainfall in the locality where the experiment was carried out averages about 60 inches a year, spread mostly over the period June to January, with a short break in September, and a few showers in April and May. The soil is a sandy loam of recent Tertiary formation with occasional bands of clay. Splitting and warping during seasoning, and insect pests (mostly borers) which attack the wood, in some cases, within a few hours of felling, are a serious handicap. The preservative was tried with the intention of killing and seasoning the trees standing, the poison helping to keep out the insects. The latter part of the experiment, though not completed yet, does not appear to have been very successful, there is no doubt, however, about the killing of the trees. The preservative has since been used to lighten the overhead cover of a 50 acre shelterwood plantation in the same locality, with equal success.

The experiment was carried out on the 20th of June 1918 at the beginning of the wet season, at the time of the heaviest rainfall, on a day with intermittent sunshine and heavy showers, and under my supervision. The girdling was about a foot wide, no wood at all cut out, and the preservative, in a pure state, being painted on to the cambium layer, in some cases while it was raining. Sixty trees were treated on an area selected haphazard, about $\frac{3}{4}$ of a gallon of the preservative being used; we reckon one gallon to be sufficient for 75 average sized (4′ 5″ girth) trees.

Below is a representative list of the trees treated and the time it took to kill them :—

Local name.	Botanical name.	Girth.	When dry.
Wild Poui ...	Oliganthes Condensata (Schultz)...	3′ 3″	August 1918.
Sacky Sac ...	.....	8′ 1″	December ,,
Crappo ...	Carapa guaianensis (Aubl.) ...	6′ 4″	August ,,
Carat Palm ...	.....	3′ 0″	July ,,
Mahoe ...	Sterculia caribaoa (R. Br.) ...	4′ 7″	August ,,
Guatacre ...	Lecythis idatimon	3′ 1″	December ,,
Gommier ...	Bursera sp.	4′ 1″	August ,,
Sacky Sac ...	.....	10′ 0″	Do. ,,
Ackirill ..	.....	3′ 0″	July ,,
Bois Oise ...	.....	3′ 7″	August ,,
Bois Pois ...	Swartzia pinnata	1′ 9″	July ,,
Angelin ...	Andira enermis (Kth.) ...	5′ 9″	August ,,
Hog Plum ...	Spondia graveolans (Macf.) ...	12′ 0″	November ,,
Wild Guava ..	Psidium Guava (L.)	2′ 3″	September ,,
Trumpet Wood ...	Cecropia palmata (W.) ...	1′ 10″	July ,,
Wild Acoma ...	.....	1′ 5″	August ,,

By the end of December every tree treated was dead.

The success of this experiment led to the use of the preservative on a larger scale on the plantation mentioned above. The trees were treated during January 1919 *(i.e.*, at the commencement of the dry season), and now (the end of April) are all dead.

It appears to me that Mr. Butterwick was a trifle premature in drawing his conclusions, some of our trees treated in the wet season took six months to die off. I am inclined to think that the next time he visits his area he will find that the trees he mentioned as being entirely leafless, or as shedding their leaves, will be quite dead, and the others, if not dead, very nearly so. The leaves do not always seem to be a sure indication of the general health of a tree; in the case of the Guatacre and Hog Plum they were not only very persistent but looked extremely healthy, in the former (a very hard wood with a distinct heart) the bark was quite dry some time before they dropped off, and in the latter, a soft-wooded tree of remarkable vitality, the bark and outer wood were absolutely rotten before the tree was finally leafless.

H. W. MOOR,
Dy. Consr., Forests,
Trinidad and Tobago, B. W. I.

26th April 1919.

FOREST ASSOCIATION.

The Honorary Secretaryship of the above hitherto held by Mr. A. J. Gibson, I.F.S., Punjab, has been transferred to Mr. R. Bourne, I.F.S., Dehra Dun, U. P.

All communications should in future be addressed to the latter.

EXTRACTS.

[We reproduce below an article from the Canadian Forestry Journal for May 1919 in which the use of aeroplanes for assisting in the detection of forest fires is described as an established fact.

The use of aircraft has already been suggested in the pages of the *Indian Forester* for the purpose of stock mapping and our suggestion that it might be possible to obtain the use of military craft in peace time appears to have already been initiated in the United States for fire detection. It appears to us that observation balloons or the small type of airship used for patrolling the coasts would be more suitable for the purpose of stock mapping than aeroplanes.—HON. ED.]

CANADA STARTS AERIAL FOREST PATROL.

FIRST EXPERIMENTS WILL BE CONDUCTED IN CENTRAL QUEBEC WITH HYDRO-AEROPLANES.

There is every possibility that Canada will enjoy the distinction of being the first nation to institute an aerial forest patrol. By permission of Hon. C. C. Ballantyne, Minister of Marine and Fisheries and Naval Affairs, two hydro-aeroplanes have been released to the St. Maurice Forest Protective Association for use in Central Quebec. At the date of going to press the Association's pilots were at Halifax preparing to bring the machines to Three Rivers.

The release of the hydro-aeroplanes for forest patrol experiments was obtained only after great difficulty. The original application of the St. Maurice Association, supported by the Quebec Government, was favourably received by Hon. A. K. Maclean, acting in Mr. Ballantyne's absence, and later nullified by Mr. Ballantyne, the latter's decision being again modified after

a meeting of a deputation of the Canadian Forestry Association and the Aerial League of Canada. The part played by the St. Maurice Forest Protective Association in negotiations is worthy of high praise inasmuch as this body volunteered to pay practically the entire expense of maintenance of machines, salaries of pilots and other items of heavy expense so as to secure, not only for the St. Maurice region, but for all the Government Departments and other private associations in the Dominion, the data absolutely necessary before any system of air patrol can be entered upon. Most observers of the negotiations will doubtless conclude that the Dominion Government has made a remarkably good bargain for the reason that several of the Dominion Government Departments have already applied for the use of hydro-aeroplanes for forest patrol and will now be able to avail themselves of the experimental results in the St. Maurice territory. The first pilot to inaugurate the patrols will be Mr. Stuart Graham, who participated as an airman in the British Government's fight against German submarines. Mr. Graham will have the fullest co-operation of the officials of the Royal Canadian Naval Air Service. Experimental work will be conducted in the use of wireless telephones and telegraphs. It is intended also to try out the use of aerial cameras in mapping forests. The possibilities of this work are most promising.

The flying boat type has been regarded as being most applicable to the conditions accompanying forest patrol in the province of Quebec where lakes and rivers are almost always within reach as convenient landing stations or in case of accidents. From the point of view of the Canadian Forestry Association, the confidence expressed by returned aviators in the efficacy of aerial patrol of forest areas and the ease of forest mapping called for immediate experimental trials. No one having to do with the securing of the Dominion-owned machines for use in Central Quebec has the temerity to advocate aerial patrol as a cure-all for forest fires nor anything but a probably useful auxliary to present means of fire detection. Recently the Government of Ontario requested from the officials of Argyll House, London,

an estimate of the cost of a system of aeroplanes for use in the forested districts of Northern Ontario. Instead of mapping out a modest experimental plan, the officials of Argyll House concocted an elaborate and highly expensive scheme whereby the Government of Ontario might easily be called upon to pay out close to one million dollars during the first year. Quite properly the Ontario Department of Lands and Forests rejected the scheme implying thereby no adverse opinion of possible advantages of aerial patrol for Ontario. The Quebec experiments will probably determine to a material degree the adoption of aeroplanes by Ontario and other provinces in 1920.

The United States Government has recently brought about a co-operative plan between the military authorities of the United States Forest Service whereby Government machines will be tested in fire detection work during the present year.—[*Canadian Forestry Journal.*]

FORESTRY BILL.

[The following is reprinted from the *Times* of 8th July 1919, being the debate in the House of Lords on the second reading of the Forestry Bill.

We cannot but express surprise that while Britishers throughout our colonies and dependencies have recognized the value of forestry, the mother-country should have required the devastating effect of a world's war to bring home to our politicians that forestry on scientific and sound principles is equally possible and necessary within the British Isles.—HON. ED.]

The *Earl of Crawford*, in moving the second reading of the Forestry Bill, said he thought that the case for an afforestation policy in this country was generally conceded. During the last 25 years the matter had been the subject of numerous inquiries, but little or nothing had been achieved, and the position in the United Kingdom gave grave cause for apprehension. Only one other country in Europe was so sparsely wooded as was Great Britain, where the proportion of land under timber was only 4 per cent. while in Belgium 17 per cent. was wooded, in France 18 per cent. and in Germany 25 per cent. Portugal alone had a smaller wooded area than had Great Britain. Moreover, the woods here

yielded only about one-third per acre of that in countries where sylviculture was developed. We had enormous areas suitable for planting timber, and we had an enormously high percentage of woodlands which demanded reproduction. Even so the depletion had gone on apace. Before the war Ireland was losing about 1,000 acres a year, and his impression was that the same process was going on in Scotland and in England. When the war broke out there was an immediate shortage of timber and the whole market became disorganized. At one moment the continuance of our coal mining was gravely threatened owing to the inadequate supply of pit props, and a great tonnage effort had to be made. Timber was one of the most bulky of cargoes, and we paid a heavy toll of the mercantile marine for the timber which we had to import; we added to our debt and we burdened our exchange. In 1915 and 1916 the increased price which we had to pay for timber, compared with the price in the two previous years, was £37,000,000. He had not the figures for 1917 and 1918, but the prices continued fabulous.

The Bill asked for £3,500,000 to be spent during the next ten years to repair our losses and to provide for the future. Broadly speaking, the Bill was based upon the unanimous report of the Forestry Sub-Committee presided over by Mr. Francis Acland. The measure would constitute a small central body of seven members, to be known as the Forestry Commissioners, who would take over the powers and duties of the Boards of Agriculture in the United Kingdom, and would be invested with power to purchase or take on lease and to sell or exchange land, to make advances by way of loan or grant with a view to promote afforestation, to undertake the management or supervision of woodlands, to promote woodland industries, and to make inquiries, experiments, and research. The Commission would be empowered to acquire land compulsorily and to enter upon and inspect land. Three assistant commissioners would be appointed, one for England and Wales, one for Scotland, and one for Ireland; four consultative committees would be formed; and there would be divisional officers in charge of large tracts of country and district officers in

charge of smaller areas, who would be responsible for the foresters, foremen and woodmen. At first sight the organization might seem formidable, but it was not excessive in view of the work to be done. With a centralizing body, such as was proposed, there would be an economy in staff.

The general idea of the Commission was that during the first 80 years 1,750,000 acres should be afforested. The scheme of the Bill extended over only ten years, and it was hoped that during that period afforestation might be achieved as follows :— 150,000 acres by direct State action, 25,000 acres by proceed-sharing, 25,000 acres by local authorities and private individuals, and 50,000 acres of existing woodlands replanted, a total of 250,000 acres. He admitted that the scheme was made when prices were distinctly lower than at the present time, and either the money must be increased or the scheme be curtailed. Lord Haldane complained that Clause 8 of the Bill would place a large expenditure of public money outside the supervision of Parliament. That was not the desire or intention of those who were responsible for the Bill. Clause 8 stated that during the next ten years £3,500,000 should be paid out of the Consolidated Fund to the Forestry Fund ; but it would provide also that annual accounts of the Commissioners should be presented to Parliament, that the accounts should be presented to the Auditor-General every year, and that the Treasury should regulate the method of handling the money. One essential was that there should be some guarantee of continuity of policy, and to that end a centralized authority was necessary. Since 1909 the Development Commission had only been able to spend 10 per cent. of its money on afforestation, and during the five years before the war he doubted very much if more than 200 acres were planted. He thought that was natural and almost inevitable. It was not the fault of the Department. It was no good blaming public departments because the progress in afforestation had been so slow, because it was natural and inevitable that the agricultural side should obtain complete priority over the sylviculture. Therefore he thought that this centralized authority was very essential, and the administrative advantages

would be very marked indeed. Uniformity of survey would follow.

From the financial point of view the great advantage of a centralized authority was that it permitted a well-defined and far-reaching policy to be laid down. It avoided the annual wrangle and struggle with the Treasury about quotas for different countries. From the point of view of the Forestry staff, a central department would mean wide and rapid promotion and that prospect opened up a real future to the clever man. In education it would mean really a University instead of three or four isolated and detached colleges. The weight of opinion supporting a centralized scheme was overwhelming in England, and as far as he could ascertain it was equally well received in Scotland. It was remarkable what had been done in the last few months, and still more remarkable how keen the public response had been to the fact that at last it knew that an authority existed which was devoting its whole time and energy to the question of afforestation. A feeling of confidence and expectation had been aroused. People who had been waiting very patiently for 25 years at last realized that a great opportunity now presented itself. The Bill gave a permanent status to a Forest Authority from which great things were expected, and he had confidence in asking the House to give it a second reading. (Cheers.)

MOTION FOR REJECTION.

Viscount Haldane moved the rejection of the Bill in the following terms :—"This House, while fully recognizing the importance and urgency in the national interest of the reform of afforestation, declines to approve a measure which seeks (1) to withdraw the subject from control by the departments of Government already entrusted with it in England, Scotland, and Ireland ; (2) to divorce it from the local development of agriculture and of small holdings and the social surroundings they require in order to make any system of afforestation effective ; and (3) to place the very large expenditure of public money contemplated outside the supervision of Parliament." It was absurd to suppose that a scheme for setting up a bureaucracy in London could stimulate

the people of Scotland and Ireland. He emphasized the necessity of taking into consideration the social conditions of the people. They must encourage holders to settle down in small communities, often in regions very remote, feeling sure that they would find the social surroundings and stimulus which would induce them to accept the life. The Bill proposed to set up a body responsible in the matter of expenditure to no Minister in Parliament. The provisions for training and research were ludicrously inadequate. He protested that the money for carrying out the purposes of the Bill was taken entirely out of the control of Parliament, for the proposition was not that it should appear on the Estimates, but that it should be found out of the Consolidated Fund.

The *Earl of Crawford* pointed out that it was expressly provided by the Bill that the amount to be issued out of the Consolidated Fund "shall be such as Parliament may determine."

Viscount Haldane was understood to say that this was not the same thing as the money being put on the Estimates. There was no Minister responsible to Parliament, and there was no means by which Parliament could get the efficient criticism when a matter came up on the Estimates. It was stated that there were to be two University centres for research but which were they to be? The scheme was being initiated on too narrow a basis. The Government ought to have brought together the great landowners, great men of science, great teachers, and those who were interested in developing local communities. The House should not be led away by a false analogy. In France great State forests existed and all that had to be done was to maintain and look after them by people who were on the land. If sylviculture were to flourish here employment would have to be found for the people when they were not engaged in forestry which was not carried on mainly in that part of the year when there was most work to be done in agriculture. A number of other industries could be developed; but the problem would not be solved by a sub-commission going from London to take charge of affairs. His objection went to the root of the Bill. The evil to be redressed was so serious that he shrank from placing any difficulty in the way of an attempt to remedy it but

he was convinced that the attempt was on lines which were too narrow, and that the Bill would lead to disappointment and embarrass the very process which it was intended to promote.

Viscount Clinton asserted that those interested in afforestation welcomed the measure as an indication that after many years of discussion the Government realized how serious was the position of this country in regard to the supply of timber. The cost which had to be met during the first years of the war owing to our deficient supply of timber had exceeded greatly that of the most extravagant scheme of afforestation which had been put forward, We were dependent upon imported supplies for nine-tenths of the timber used in this country, and while the demand was ever increasing there was little prospect of any additional supply. Practical people would not be willing to trust for a development of home-grown supplies to those methods which had been tried and found wanting. The Development Commission had spent upon afforestation only £250,000 including the amount of loans advanced although it had more money at its disposal. To carry on forestry properly you wanted not only knowledge, but interest and enthusiasm. Unless you had this you had not the driving force behind you to carry on the afforestation scheme. With regard to the financial clauses of the Bill, it had been said that grants or arrangements might be made with private owners for the carrying on of the work. It would be of enormous importance to the State if they could persuade owners to do some of the work. (Cheers.) We must have timber in the country in some way (hear, hear), and we must have it profitably if we could. It was quite clear that in the present case the most profitable way of growing timber would be to persuade someone else to grow it for you, even if they had to give them cash to persuade them to do it. (Hear, hear.) In his opinion grants should be made to owners to encourage them to get on with the work. (Hear, hear.) If the owner accepted a grant, the State should have a lien over the timber and be able to purchase it at any time.

The *Earl of Lancaster* said the war had convinced them of the absolute necessity of having a large supply of timber in this

country. If there was a genuine desire to make the country self-supporting in regard to timber, the great thing was not to set up a commission and appoint lecturers, but to employ people to dig holes and plant trees. (Laughter). He was afraid that the Bill was neither fish, flesh, fowl, nor good red herring. (Laughter.) He did not know whether it was to teach foresters to go in for research or science or to supply the country with timber in the next 40, 60 or 80 years. The first necessity was that the Government should set to work to plant trees and help private owners to undertake the work. It was only right that the Government should deal fairly with owners with regard to taxation. (Hear, hear.)

A SERIOUS SITUATION.

The *Duke of Sutherland* said that the situation had become a very serious one. Travellers in the woodland districts of England or Scotland could not fail to notice the terrible bareness, he might almost say devastation, apparent in all directions. This was the ungrudging sacrifice made by this country to the war, but now the time had come to repair the evil and introduce a measure to co-ordinate the action of local authorities. There were great tracts of country where woodlands could be satisfactorily established and industry carried on. He pointed out that period between planting and cutting was a very long one, and the men who sowed could never reap his crop. The landowner's future was such an uncertain one in this country that he naturally hesitated before embarking on a large capital expenditure for a scheme, the fulfilment of which he would probably never see. It was, therefore, a matter that must be taken up by the State on the lines of the Bill before the House. (Hear, hear.)

Lord Lovat, who was a member of the Reconstruction Committee and of the Interim Authority on Forestry, said they unanimously arrived at the opinion that the time had come when the trees ought to be put in the ground. (Cheers.) He thought it was quite certain that if they had one organization which would give a lead and an indication of the way in which research ought to go, there would necessarily be an absence of duplication of work

and they would have all the ground covered in a better and more efficient way than if they had three departments moving on uncontrolled lines. It was better to have one forestry service acting throughout the country as was the case in France and America. He did not wish to criticize either the Board of Agriculture or the Development Commissioners, but if we compared what had been done in Great Britain with what had been done in France, with its single authority it was really horrible. If we had had a single authority we should have saved probably millions of pounds by the prevention of the devastation of the woods which was going on at the present time. He denied Viscount Haldane's assertion that the question of research had been regarded from a niggardly point of view, and pointed out that from the first the Interim Authority had been in touch with the Imperial College of Science and Technology with Edinburgh and Oxford and Cambridge, and work was being done in certain directions which had not been done in all the ten years during which the Development Commissioners had held the reins of office. The amount of work to be done by the existing Boards of Agriculture in the several parts of the United Kingdom made it necessary that there should be a separate authority to devote the whole of its time to forestry.

The *Earl of Selborne* said that when he was President of the Board of Agriculture he realized that the existing machinery for dealing with forestry was wholly inadequate, and that unless it were centralized forestry could not be made a great national industry. When the war broke out it became necessary to set up a central body to deal with timber supplies. The position of this country would be perilous should we have the misfortune to be engaged in another great war within the next half-century.

The amendment was negatived without a division and the Bill was read a second time.

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THE MANAGEMENT OF A TEAK FOREST.

In an article published in the *Indian Forester* for April 1919, I attempted to criticise the management of the unclassed forests of Burma, and ventured to suggest that our policy, while exceedingly expensive, fell short of perfection in that, in the near future, there was likely to be a serious shortage of timber for local requirements. It may, therefore, be of interest if I supplement this with a similarly frank expression of opinion on the management of the reserved forests maintained for export purposes.

The trend of opinion in Burma has set strongly in favour of converting our natural teak forests into even-aged woods. The leading exponent of this view is a highly distinguished and able officer who, for many years, was Imperial Sylviculturalist to the Department, and in order to find out how he arrived at his conclusions, I have been reading what is really a beautifully illustrated text-book on Forestry, but which he modestly calls "A Note on some European Sylvicultural Systems, with Suggestions for Improvements in Indian Forest Management," in which he expounds this view in more detail than I can find elsewhere. The reasons put

forward, however, strike me as singularly unconvincing. He has been a superspecialist in a branch of knowledge in which we are all specialists, and has been in a unique position to obtain information of sylvicultural work carried out in all parts of India and Burma, but practically his only argument in favour of conversion is based, not on experience gained in this country, but on the fact that in Europe the leading authorities have come to the conclusion that the selection system is unsuited to their requirements.

Forestry is purely a money-making affair like any ordinary business, and therefore it is an axiom that the first consideration should be finance. Thus, before embarking on any big scheme, a sound business man would find out whether the finances of the firm could stand the strain and would make certain, not only that the scheme would yield a profit, but, as accurately as possible, what rate of profit. The other axiom of Forestry is that, as profits depend largely on the local conditions, these conditions should be very carefully studied. It is to the very thorough manner in which the financial results of any operation have been worked out, and the care taken to study local conditions, that European forest officers themselves attribute the very high standard of excellence attained on the Continent of Europe, and I maintain that in Burma Forestry is in a most deplorable state of muddle owing to the wilful disregard of these axioms.

To give a few instances, I do not think it can be denied that indiscriminate fire-protection was undertaken in Burma merely because the leading authorities on Forestry in Europe had come to the conclusion that it was essential to keep fire out of a European forest. The conditions in Burma and Europe are, however, utterly dissimilar, and as no attempt had been made to work out the financial results of this operation, it was from a business point of view a senseless gamble, which, however, like any gamble might have turned out well. The disastrous effects of this operation have gradually become apparent, and most forest officers will now, I think, admit that, in this case at least, the wilful disregard of these axioms has resulted in a waste of many lakhs of rupees.

Even from a business point of view there was a certain amount of plausibility in the idea that teak might thrive better if fire were excluded, but every forest officer knows that every tree, whether light demanding or shade enduring, requires light for development, and to my mind it is very characteristic of the ideas which prevail in Burma that whereas without exception every teak sapling growing in a plantation receives the attention it requires, not once, but at regular intervals throughout its career, the chance of any natural teak sapling receiving any attention at all is negligible.

There are in the Katha Division two reserves which, owing to their diminutive size, absence of bamboo, and presence of patches of pure teak, are quite abnormal, and in my view these reserves should be quite the last place to select for carrying out experiments to determine the most suitable method for working a teak forest. These forests, however, in many ways resemble a European forest, and it is, apparently, entirely for this reason that whenever a forest officer is posted to that division, he immediately sets to work most busily on those reserves.

This activity contrasts most curiously with the vacillation and indecision displayed in the case of an ordinary teak jungle. Usually nothing is done but occasionally a few keen individuals will set to work, in the most pathetic manner, in creating odd little patches of pure even-aged woods of the type to which they were accustomed in the period before they were fledged. It is useless pointing out that according to enumerations the seedling class already greatly predominates in numbers, and that they are unable to protect from suppression the young teak saplings and poles already on the ground. They seem unable to take advantage of work already completed and seem impelled to make a fresh start from the beginning.

The author of the treatise referred to was at one time converted to what I consider the orthodox view. It was he who, breaking away from the traditions of the Service, collected statistics showing the disastrous effects of fire-protection on the natural regeneration of teak, and thus delivered the first shrewd blow from which the advocates of indiscriminate fire-protection never

recovered. It is all the more sad, therefore, that he should have backslidden, and should have used the great influence of his position to denounce methods solely on the grounds that these methods have proved unsatisfactory in Europe.

I admit that European forest officers thoroughly understand their own business, and as they consider the selection system unsuited to their requirements, it may be inferred that there is some sensible reason for their objection. The explanation is very simple. In Europe it is usual to cater for the requirements of small towns, the markets of which are readily disturbed by irregular supplies. Generally prices rule higher in the small towns than in the large import towns, and as timber is costly to transport, irregularity of supplies reduces the profits both ways. Under the selection system in Europe, however, a considerable degree of irregularity of the yield seems inevitable. Theoretically under this system a normal forest is one which contains a normal series of age gradations, but in practice there is insufficient evidence to determine what the proper proportion of trees in each class should be, and further, having arbitrarily fixed on certain proportions as a standard, it is almost impossible to carry out the thinnings in such a way as to attain or maintain those proportions.

The main, if not the only, objection to the selection system in Europe is, therefore, that under this system it is impossible to ensure the high degree of regularity of yield which is considered essential in order to obtain the highest rate of profit.

In Burma, however, these considerations do not apply. In the first place, as I shall endeavour to show later, our forests are perfectly normal. But apart from this, practically the whole of our outturn is exported to the European and Indian markets, and therefore assuming a similar irregularity of the yield, in Burma as in Europe, we may reckon on the fact that part of the irregularities of individual forests would cancel out in the provincial outturn and that any remaining fluctuations would not seriously disturb the world's markets. As a matter of fact, even from forests in which the exact number of trees to be girdled annually has been definitely prescribed, the actual outturn varies very greatly owing to the

enormous differences in the floating seasons, and it is a matter of common knowledge that these fluctuations of outturn exercise very little influence on the price of teak. To abandon a system which is in many ways admirably suited to an undeveloped forest on account of a doubtful theory that under another system a higher degree of regularity of the yield would thereby be ensured, seems to me to be the height of absurdity.

Nevertheless the main objection to conversion is that, although intended ultimately to ensure a more regular and sustained yield, it would actually have the contrary effect. In considering the question of forest management, the outstanding fact to be borne in mind is that in the ordinary course of events we have to expect a very serious decrease of outturn as soon as the existing surplus of overmature trees has been removed. As the period is usually fixed at 30 years and the exploitable size at 7′ 0″ girth, the normal yield consists of trees ranging from 7′ 0″ girth to 7′ 0″ plus 30 years growth or roughly 8′ 0″ girth. It is the practice, when girdling, to enumerate all trees over 6′ 0″, and I am therefore able to give the following figures for the teak in an area girdled over in a typical division in one year. Actually 11,851 trees including 2,854 immature trees were girdled, but the total growing stock of trees both girdled and left was as follows:—

6′ 0″ to 6′ 11″	...	5,822 trees
7′ 0″ to 7′ 11″	...	5,095 „
8′ 0″ and over	...	8,384 „

The normal annual yield is therefore about 5,000 trees, but the surplus of overmature trees is even in number of trees very much greater than the normal yield, and if volume is taken into consideration about double the normal yield. There is a similar surplus in every teak forest, and as in every case it has been arranged that the whole of the surplus shall be removed by the end of the second period, and as with few exceptions the second period will have expired some 50 years hence, we may calculate that by that date the provincial outturn of teak will have fallen to about a half what it is at present.

We already spend about 40 per cent. of our revenue, and some 50 years hence, when the outturn has been reduced to a half, the proportion will automatically be increased to 80 per cent., assuming that the expenditure remains the same. Any scheme of conversion, however, instead of sustaining the yield at this critical period, must tend to increase the difficulty. For instance, assuming that it is attempted to convert half the forest in the first rotation of 100 years, in 50 years a quarter of the area will have been rendered unproductive of teak for the European market, and therefore reduce the revenue a further 25 per cent.

As regards expenditure, we speak lightly of conversion, but as teak forms a very small proportion of the growing stock, conversion actually means reafforestation, which, considering the enormous areas involved, must necessarily be an extremely expensive process. In the case of taungya plantations in Lower Burma, it was found that, although at first everything went smoothly, the taungya-cutters doing all the work with little supervision, yet that after some 30 or 40 years the work became so great that the practice of creating even-aged woods had to be abandoned. We have now a much larger and better establishment, but it is proposed to conduct operations on an infinitely larger scale, and, judging from this experience, it seems certain that the cost of continuing conversion and the enormous staff required to tend the large number of even-aged woods created will, some 50 years hence, place a great strain on our finances and establishments, and combined with the serious decrease of revenue, will result in a state of financial chaos. Theoretically, in a further 50 years the balance would be restored, and an outturn obtained even higher and more regular than at present and more easy to extract, but this would be a poor consolation, if in the meantime the department had become discredited and bankrupt.

On the view that it is essential to study the local conditions, by far the most important feature of these forests, and the one which in particular distinguishes them from the forests of Europe, is that they are natural forests, and it follows, therefore, that one

may avail oneself of the considerable mass of knowledge which has been acquired by a study of Natural History. In the case of man it is a matter of common knowledge that many calculations, such as those relating to insurance and conscription, are based on the fact that man is arranged in what we call in Forestry "a normal series of graduations," and everyone is familiar with the explanation that this is due to the incessant struggle which man may be said to be waging with disease, the forces of Nature being so nicely balanced that the mortality at each period of age remains constant. In a natural forest all species of trees undergo a more direct and more severe struggle for existence, and therefore we may, I think, assume that a similar state of uniformity must prevail. We know that each species of tree produces approximately the same amount of seed annually, and therefore it is easier to understand that the regeneration of a tree should be normal than that the birth-rate of an animal should be constant. Similarly in the case of a tree the mortality depends mainly on growth, which is a constant factor, and each generation is exposed to the same perils, such as a dense growth of bamboo in one locality or thick grass in another, and therefore it is easier to understand that the mortality at different ages should be constant than in the case of man where the principal causes of mortality are due to invisible microbes. We are, therefore, I think, safe in assuming that in a virgin forest each species of tree must be maintained in a state of equilibrium or balance, and that each species must be arranged in a series of normal age gradations.

The classes adopted for working-plan enumerations are irregular and make it difficult to trace the gradations, but so far as they go, the statistics support this contention. Whereas in an artificial forest, which is seldom perfectly normal, the older age classes frequently contain more trees than some of the younger classes, in Burma it is invariably found that the numbers are graduated in the manner one would expect on this view.

Assuming therefore that teak is arranged in a series of normal age gradations, it is merely necessary to determine the distribution of teak throughout a forest and to divide the forest

into 30 coupes, each of which contains approximately one-thirtieth of the growing stock of teak to ensure a regular yield to the end of the rotation. Just as in the case of conscription, it may be assumed that when the number of recruits available for training from a country or district has been determined, the same number will be available in future years, so in the case of teak we may concentrate our energies on enumerating the exploitable trees, and may rest assured that there will be sufficient trees in the younger gradations to maintain the normal yield. Personally I would enumerate all trees over 5′ 0″ in girth over 25 per cent. of the forest in four classes, a 5′ 0″ class included only to ensure all trees over 6′ 0″ being enumerated, 6′ and 7′ classes from which the normal yield could be calculated, and a class of trees 8′ and over from which the surplus could be calculated. As large trees are comparatively few and easily seen, the work would be inexpensive and could be carried out by any intelligent Forest Guard. With 8 or 9 enumerators, preferably working independently, I would detail one or two more senior subordinates to recount selected sample plots with a complete series of foot classes for the purpose of checking the original enumerations, providing data for working out an actuarial table of the natural normal mortality, and assessing the appreciation or deterioration of the forest in future years.

With a 25 per cent. enumeration it should be possible to obtain a very accurate estimate of the yield, but under present methods the cost of a working-plan works out to over Rs. 100 per square mile, which is about one rupee for each exploitable tree actually counted (which is obviously a bit stiff) and even so it is notorious that the estimates are hopelessly inaccurate. The calculations of the yield are usually very elaborate, but palpably incorrect. For instance, in the plan of the forest in which I am working, it is calculated that, although only 118,124 first class trees were enumerated, 130,251 trees will be available for exploitation. This result is obtained by calculating that even in a 24 year period a large number of immature trees will enter the first class before girdling takes place, and that there

will be an absurdly low rate of mortality among the first class trees. Seeing that these forests have been practically untouched, it is not clear why on this rate of increase the forest does not contain mature trees and nothing else. Similarly the working-plans officer has allotted fewer trees to the coupes to be taken in hand towards the end of the period.

As regards the revision of a plan at the end of the first period, it is possible, while girdling, to obtain an extremely accurate idea of the distribution of teak throughout a forest, and therefore it should be possible to make adjustments so as to ensure a far higher degree of equality of the future yields. Obviously also, the volume which could be accurately determined should also be taken into account. On my view a full 25 per cent. enumeration would be unnecessary, but it would be essential to enumerate the teak in the series of standard sample plots, comprising about 2 or 3 per cent. of the area, in order to assess the deterioration or appreciation in value of the growing stock. I attach the greatest importance to this as if once forest officers could be brought to realize how steadily the forests were deteriorating under their management, there would be some chance that existing methods would be overhauled.

A large number of plans will shortly expire, and on the assumption, which seems to me ridiculous, that the department is terribly undermanned, there seems every indication that the revision of these plans will be carried out in a very casual manner, and I hope, therefore, nothing I may have written will be taken to justify such methods. I have been discussing Forestry as it might be, and not as it is, and in most cases girdling has been carried out in a very irregular manner, and little attempt has been made, while girdling, to determine accurately the distribution of teak.

The Research Institute has classified our working-plans into a large number of systems of management, but in view of the fact that our working-plans consist merely of a felling scheme, I venture to assert that management in the true sense of the word has not yet been started in Burma. Taungya-cutters, who frankly regard the forest as so much manure, often carry out fellings just

as systematically and under a definite rotation, but they do not profess to be undertaking forest management. The management of a forest consists of much more than the preparation of a felling scheme, and as in agriculture comprises sowing, tending and reaping operations.

On the whole the felling scheme of teak forest is based on sound principles. The yield is restricted to the productive capacity of the forest, the whole forest is gone over systematically and within a period sufficiently long to allow a new crop of trees to attain maturity, and the annual coupes are arranged in such a way as to furnish regular and equal yields. In fact the standard is so high as to make it practically certain that the original lines were laid down by one of the three German forest officers who joined the department, and brings into glaring contrast the inadequacy or absence of felling schemes for species other than teak, and the lack of any suitable sylvicultural scheme to supplement the felling scheme.

As regards the principles which should be observed in preparing a sylvicultural scheme for a forest, I would point out that a forest should be treated as a whole, and a uniform system of treatment prescribed. This does not prevent two or three separate methods of treatment being applied, but it precludes, for instance, fire-protection being applied to one part of the forest and the remainder left unprotected, or two or three compartments being treated in a very intensive manner and the remaining area entirely neglected. In lectures on Forestry it is usual, when expounding this principle, to refer in a jocular manner to the case of the dear old gentleman who potters about his estate, and whenever he finds a suitable spot, dibbles in an acorn, and, making allowance for the difference in scale, it is rather amusing to find that this example is faithfully followed in the way taungya plantations are frequently scattered haphazard throughout a reserve. This sort of thing indicates a most excellent spirit, but does not make for uniformity which in forestry is so essential.

It is also necessary to realize that the proportion of revenue devoted to the maintenance and improvement of the capital

value of a forest should be a reasonable one. For instance, in the case of the famous Mohnyin reserve the proportion is far too high, while in the case of an ordinary teak forest the proportion is far too low. Both are equally serious mistakes. In a typical teak forest the yield per acre is small, and therefore it follows that any scheme of sylvicultural operation should be, although adequate, extremely simple and inexpensive. This is the most difficult point for any Englishmen, or even Scotchmen, who with their greater acumen in financial matters generally display a greater aptitude for Forestry, to realize, as we are on this point so greatly led astray during our course of training. In Europe every forest is fully stocked with valuable species, and in order to obtain the highest nett profit per acre, very intensive forms of culture are indicated, and within limits expense is no object, provided that corresponding results are obtained. In Burma, however, teak only forms a small proportion of the growing stock and therefore our object is entirely different, namely, to increase the yield per acre, and with a small expenditure to obtain the greatest possible result.

As I have already pointed out, we have to anticipate an exceedingly serious decrease of yield some 50 years hence, and therefore it is indicated that we should take steps to sustain the yield at that period. It may also be noted that, as the effect of removing a large proportion of the seed-bearers of one species only is to reduce the regeneration of that species below the normal, we should take steps to counteract that effect.

As regards the actual methods to be adopted, I do not think we can do better than again seek inspiration from Natural History, and to my mind the most apposite case is game preservation as practised in England. Here we have the case of a species occurring naturally, of which it has been proved that the stock can be increased to such an extent that large numbers of game can annually be killed on an estate where formerly the game was very scarce

The means adopted are the reduction of the natural normal mortality to which the species is subject, and only in the case of

exotics, or where money is no object and it is desired to raise a particularly large head of game, artificial rearing.

In the case of teak the fact that a tree planted in a compound or avenue is practically certain, unless deliberately cut down, to attain large dimensions, proves that the only serious cause of mortality to which teak is subject is due to the competition of the species with which it is associated, and it is therefore indicated that we should go systematically round our forests and, so far as possible, free all suppressed trees. I do not think, however, that it would be possible to eliminate all mortality. For instance, although teak is popularly supposed to be a light demander, one often finds etiolated seedlings in the most unpromising positions, and although it might be possible to free even these by repeatedly cutting back the bamboo, etc., the expense would not be justified. For practical reasons I do not think it would be possible to get over the whole forest in less than ten years, and therefore I would restrict operations to freeing only those trees which, with a reasonable amount of assistance, would be likely to carry on for another ten years. This would include practically every tree over 3′ 0″ girth. Most of such trees have penetrated the bamboo canopy, and, if freed, it is most unlikely that they would again be overtopped by other trees growing from below. Not only is "the present worth" of such trees relatively high, but the cost of ensuring that they will reach maturity is comparatively low, and therefore the operation is highly profitable. In addition it might be worth while to give some assistance to some of the more promising poles and saplings. Assuming that whereas at present, say, 10 saplings win through the bamboo canopy without any assistance, it is reasonable to suppose that with a certain amount of assistance a further 10 or 20 saplings could be assisted into the overwood. Generally, however, it is only proposed to attempt to control the tree growth, partly because this gives greater results for a limited expenditure, and partly because of the urgency of sustaining the yield at the critical period about 50 years hence. Later on, however, it may reasonably be hoped that the manufacture of paper-pulp from bamboos may be largely developed, when by regulating extraction,

it may be possible also to bring the bamboo growth under control.

The cost of such operations varies with the density of teak, and therefore with the revenue, which is a consideration, but on an average works out to about Re. 1 per acre, and this would be materially decreased if some method could be discovered of killing softwood trees without felling, *i.e.*, by girdling and painting on the band some composition which would be absorbed into the tissues and kill the tree. On an average the revenue from teak forest is about Re. 1 per acre per annum, and therefore with a rotation of ten years the expenditure works out to about 10 per cent. per acre per annum. Allowing a further 10 per cent. for cost of supervision, the expenditure amounts to 20 per cent. of the revenue, which is not an unreasonable proportion to devote to the maintenance and improvement of the capital value of a forest.

I cannot, of course, prove that these operations would yield "the maximum results with the minimum expenditure," but I can at least give what I consider sound reasons for thinking that very appreciable results could be obtained at a comparatively low cost, and if anyone can show that still better results could be obtained by other methods, so much the better. For mathematicians the following table prepared by the Research Institute from a large number of enumerations may be of interest :—

Girth.	Corresponding Age.	Proportion of Trees.
6′ to 7′.	130 to 155	5
4′ to 6′	90 to 130	10
3′ to 4′	58 to 90	17
Under 3′	1 to 58	61

A census according to ages naturally forms an actuarial table of the mortality to which man is subject, and similarly an enumeration of teak by age or girth classes must, I think, form an actuarial table of the natural normal mortality to which teak is subject. This table therefore gives a basis for calculation. Except in the rare cases where teak competes with teak, practically all the normal mortality over 3′ 0″ girth could be eliminated and a proportion of that below 3′. The Research Institute also

calculates that in a natural forest the growth even of those trees which successfully win through to maturity is retarded by suppression, and that by giving trees a reasonable amount of room, the time taken by the average tree to reach maturity could be reduced to 100 years, and allowances must be made accordingly. Again it is known that a large proportion of trees suffer injuries owing to suppression, and are bent over or deformed, in fact a perfect tree is an exception, and therefore the value of the average tree could be increased by preventing these injuries.

These calculations are, however, rather abstruse, and the ordinary individual may perhaps better realize how effectively the proportion of any species may be altered by imagining an attempt to exterminate all teak over a given area. For instance, in a compartment where teak formed about 5 per cent. of the growing stock, a smart gang of coolies could, I think, in a very short time, fell every single teak tree, sapling and seedling. The work would probably not cost more than about Re. 1 or Rs. 2 per acre, and it can hardly be doubted that in a year or two the jungle would completely close in leaving no trace of the teak. To increase the proportion of a species is, however, just as simple as to reduce its proportion. We know that teak is exceedingly responsive to light, and it is found in plantations that 1,000 seedlings per acre dwindle down in 100 years to 20 trees which means that in this time teak increases 50-fold the proportion of the area it occupies and therefore it is obviously just as easy to favour the teak at the expense of the jungle as to let the jungle encroach on the teak, and to increase the percentage from 5 to 10 per cent. as to reduce it from 5 to nil.

There remains the question of natural regeneration which apparently causes so much anxiety. We know, however, that the mortality due to growth is very great. As pointed out, in a plantation the trees gradually dwindle down from 1,000 per acre to 20 in a period of 100 years, which means that for every tree which reaches maturity 50 become casualties for want of room for growth, and although in a natural forest the natural normal mortality, as proved by the actuarial table put forward,

is surprisingly small, it is nevertheless clear that sufficient trees could be saved which would otherwise die a so-called natural death, not only to restore the balance, but to increase the natural regeneration by an amount which would be equivalent to a considerable area of taungya plantations.

An officer acquainted with my views, but not with Burma, very kindly wrote to me and pointed out that he failed to see that any possible harm could follow from establishing artificially a full crop, preferably mixed, by the uniform system, not necessarily in one compact block, but wherever the conditions of the growing stock justified it, at the same time carrying out improvement fellings and thinnings on the rest of the area so as to ensure the future yield to the rest of the rotation. He considered that we should have the higher value of our yield, when concentrated by the uniform method, as a set-off against increased cost of formation, and that the skidder would replace the elephant and mechanical means of transport rendered possible. He added that we must set aside difficulties of staff as these must be overcome.

At the outset, there is, I think, a tendency to confuse the fact that our forests are uneven aged with the fact that they are also incompletely stocked with marketable species. I understand that in America, where mechanical transport is more largely used than in any other country, the forests are, without exception, uneven aged, and this tends to prove that mechanical means of transport are not dependent on the adoption of the uniform system.

In the elephant we have a very powerful animal which abounds in Burma, can without great difficulty be caught and trained, and costs little to feed. Ordinary labour is comparatively cheap, and we have an excellent network of floating streams. On the other hand, mechanics are comparatively expensive and, when sick, difficult to replace, and the country is so broken that it is difficult even to make well-graded bridle-paths. Anyway, so far as I am aware, no real expert has expressed an opinion that were clear fellings made or the uniform system adopted, mechanical means of transport dependent on a prepared track would be a sound business proposition, and while indulging in futurism, why not go

the whole hog and have visions of timber being extracted by airships, in which case the accumulation of large quantities of timber at one place would not be necessary? The conditions are very different in the case of the more accessible forests in the foothills where extraction could be carried out in connection with the railways, but forest officers in Burma only contemplate the adoption of the uniform for the teak forests on the main watersheds, and propose to retain the selection system for the forests from which local needs are met.

In order to obtain a large stock of teak, there is, in my opinion, not only no harm in a system of teak preservation combined with artificial rearing, but, on the contrary, I should be only too pleased to see such a scheme taken seriously in hand. The only little difficulty I can suggest is the matter of funds to finance such a project. The teak forests of Burma are, as it were, a gift of the gods, and not our own handiwork, and as the Province is sadly in need of funds for many purposes, it is only reasonable that the present generation should derive a certain amount of benefit from these forests. On the other hand, we hold these forests in trust, and it is only right that we should hand them on to the next generation with their capital value intact or, if possible, considerably improved. On the whole I think 60 per cent. of the revenue, the maximum we can hope to retain for this purpose, and anything from 40 to 60 per cent. a reasonable allotment. I do not think, however, that it is generally realized that when a species commands a high royalty value, a low allotment is indicated. It is equally desirable to maintain the supply of a timber with a low royalty value as one with a high value, but unfortunately the cost of sylvicultural operations does not vary with the royalty value. Thus in a teak forest yielding annually a revenue of Rs. 4,00,000 at Rs. 20 a ton, an allotment of 40 per cent. would allow Rs. 1,60,000 for expenditure but in a Pyingado forest yielding exactly the same volume of timber with a royalty value of Rs. 5 per ton, the revenue would be only Rs. 1,00,000, which even with a 60 per cent. allotment would only permit of an expenditure of Rs. 60,000. The point is of

some importance as we have devoted ourselves hitherto mainly to teak forests, and there is every prospect that in the near future a trade will be developed in inferior timbers, in which case we shall be called upon to maintain the supplies. In my opinion, therefore, we should, in the case of teak, endeavour to keep down to a 40 per cent. allotment, and what is more to the point is that hitherto the Local Government has not shown any disposition to grant a larger allotment.

We already spend, however, about 40 per cent. of the revenue and of our expenditure very little is devoted to sylviculture, and when therefore it is lightly suggested that we should embark on a magnificent scheme of conversion, and at the same time carry out improvement fellings systematically over the remaining area, the humour of the situation from my point of view lies in the fact that, although the question of finance should be a forest officer's first consideration, it is evidently the last thing he thinks of.

The scheme I have put forward is in comparison extremely humble, but to enable, even this scheme to be carried out, I consider it would be necessary completely to overhaul our finances, especially those in connection with the management of unclassed forests, to reorganize our establishments for forest works, and to create an efficient labour supply, and in particular we should have to revise our ideas as to the amount of labour we can effectively supervise. To restrict the yield of a forest to its productive capacity and to carry out sylvicultural operations to ensure the maintenance and improvement of the capital value of a forest is the essence of Forestry, but there are few cases in the British Empire where such an object has been attained, and I consider the chances of attaining a fair standard of Forestry in Burma are now extremely remote.

The only little matter which seems to cause anxiety is "the paucity of establishment," which will probably be remedied in the near future. In this connection a few statistics derived from the last quinquennial report for the years 1909—1914, *i.e.*, before expenditure on sylviculture had been reduced owing to the war, may prove of interest. During this period the average annual

revenue was Rs. 1,04,20,259 and expenditure Rs. 40,69,971, or rather under 40 per cent. The amount spent under B, establishments, was Rs. 21,02,468, or about 51 per cent. of the expenditure, while the amount spent under subheads A VIII e, f, and g, which include all works which by any stretch of imagination can be called sylvicultural operations, was Rs. 4,02,613, which is under 10 per cent. of the expenditure and under 4 per cent. of the revenue, more than half of which was incurred on fire-protection. Incidentally in the previous five years, from 1904 to 1909, the expenditure under B was seven lakhs less, while the amount spent on sylviculture was half a lakh more, which affords food for reflection.

Judging from these statistics the principal function of the Forest Department is to provide comfortable billets for as many deserving persons as possible, but the department was orginally created for the purpose of maintaining and increasing the valuable teak supplies of Burma, and it may be of academic interest, some 50 years hence when the effect of our management has become apparent, to reflect how such an object could have been attained.

H. C. WALKER, I.F.S.

July 1919.

LUMBERING IN THE UPPER SUTLEJ VALLEY (PUNJAB).

PART I.

There is at present a very general shortage of timber throughout the Punjab owing to the depletion of stocks through export to various theatres of war operations during the last few years. Coniferous timber is in great demand by the Railway for sleepers, by the Military Works, and by the general public, and it may perhaps be of interest to describe lumbering operations now being undertaken by the Forest Department in the Bashahr Division.

Traders' Leases.—For many years timber was extracted by Government agency, mainly in the form of logs, till in 1908 a lease of the main fellings was given to the Sutlej Forest Company, which lease after various extensions terminated on August 31st, 1918. The deodar forests were worked to their full annual yield as

provided in the Working Plan, the more accessible blue pine forests were cut over, some of the chir forests were worked, but the very extensive spruce and silver fir forests were practically untouched.

Log working was soon abandoned by the Company as logs take at least two or three years to reach the sales depôts in the plains and the consequent heavy interest charges and the expense of building rolling roads proved too great for the Company's finances. The rapid increase in the price of the deodar railway sleeper rendered returns from sawn scantlings more certain and profitable and the Company converted the whole of its outturn of about 10,000 tons annually to sawn scantlings.

Some of the work done by the Company, notably in floating scantlings in permanent or telescopic slides past cataracts in side streams, and in the designing and utilization in precipitous country of simple portable wire ropeways up to 3,000 feet span was of a high standard.

Reversion to Departmental Extraction.—In September 1917 departmental extraction was reverted to and orders were received to increase the supply of timber to the maximum extent possible in view of the urgent requirements of the Indian Munitions Board.

The Bashahr Forest Division consists of the Leased Forests of the Bashahr State, and, commencing from fifty miles north-east of Simla stretches to Thibet, and contains the forests of the Upper Sutlej Valley. The river cuts through the mid-Himalayan range and the forests lie on steep to precipitous slopes and in the catchment areas of side streams, the forests in the main valley generally being separated from the river by three or four thousand feet of precipitous and bad ground. The country and local conditions have been described in the *Indian Forester* for the month of November 1915 in an article entitled "Fifty Years of Forest Administration in Bashahr"; for the purpose of this article it is sufficient to note that the country is probably the steepest and most precipitous in which lumbering operations have ever been attempted, that worse floating streams do not exist, many of them being so bad as to render floating of scantlings impossible and absolutely to prevent the floating of logs.

Logging Operations.

Export of timber in the form of logs from the remote forests of Upper Bashahr has several advantages, chief of which are that the local labourers thoroughly understand log work whereas they are useless for scantling work, the import of food supplies is reduced as local logging gangs provide their own food, less wastage of timber occurs in the forest and less breakage in the river, and deodar and kail logs of all sizes fetch very high prices in the plains where they are in great demand.

Mature deodar and kail trees occur for the most part in scattered woods, most of which have been worked over before, and are consequently in an advanced stage of regeneration There is, therefore, no chance of the introduction of expensive machinery proving profitable in the deodar and kail forests owing to the operations not being sufficiently concentrated. The chief problem is to control the logs by manual labour to such an extent that they do not smash themselves in the precipices or damage advance growth in their journey to the rivers. It may be noted, however, that in the case of the extensive virgin spruce and fir forests hydraulic-electric machinery may shortly be introduced.

Felling.—Felling is always done with the axe, it being found quite impossible as well as undesirable to use the saw on the steep slopes on which the trees stand. All trees are lopped to the top before felling, and in order to direct their fall a rope is almost invariably used, consisting of a $3\frac{1}{2}$ inch circumference manilla rope about 180 feet long for all big trees and a $2\frac{1}{2}$ inch circumference manilla rope for smaller trees of 6 feet and under in girth.

Trees are in nearly all cases felled directly uphill in order to save breakage of timber. The axe-cut is made at right angles to the line of greatest slope straight across the stump and the cut on the upper side of the tree is driven at least two-thirds across the stump, which on its uphill side is not more than six inches high and is more often flush with the ground. Above and parallel to it on the lower side of the tree a second cut is then made, at the same time a strain being placed on the rope, one end of which is lapped round a standing tree. The second axe-cut is extended

and the strain is gradually increased by members of the felling gang so that the fall of the tree is guided directly uphill. This method results in the minimum damage to the tree itself as it generally rests with its butt on the stump, and if, by any chance, it jumps its stump, as occasionally happens, it comes to far less damage by plunging downhill butt-end foremost than if it had started from a horizontal position. By falling straight uphill a lopped tree can only plough a clean line through advance growth which is consequently rarely badly damaged, damage generally resulting when trees are felled criss-cross and without lopping. The success obtained in saving timber and in not damaging young growth completely vindicates the rather strict rules enforced by the Department in traders' leases in the Punjab.

Trees are felled in directions other than uphill only when they are liable to break on rocks immediately above these or when there are particularly valuable patches of advance growth which it is desirable to save. As a general rule the ground is far too steep to allow departure from this practice without risk of smashing the falling tree to pieces.

Logging.—Logging is done with an ordinary cross cut saw, the logs being first measured and their lengths marked off on the tree by the Moharrir in charge. The nature of the ground, and especially the number of rocks in the rivers, render it impossible to work out logs of greater length than 16 feet, while logs of 12 to 15 feet girth and upwards are brought down in 12 feet lengths.

Rolling Roads.—The construction and form of rolling roads have not altered considerably since Colonel Bailey described them in the *Indian Forester* in 1889. They consist of well-graded roads of about 12 to 14 feet in breadth and 1 in 10 gradient, and their object is to enable logs to be brought round and above precipices on to the shoots. The retaining walls are made with wooden binders and stone and on the surface of the roads poles are laid parallel to one another over which the logs are rolled. Logs are brought on to these rolling roads from the earthen shoots or slides and are rolled over and over by means of wooden levers, care being taken to prevent them getting up speed or falling over

the edges. This is slow work and the cost rises more in proportion to the length of the rolling roads than to the length covered by the shoots ; but on the proper planning and alignment of the rolling roads depends the successful extraction of the timber.

Shoots.—In easy ground earthen shoots are used with a few check-walls, the latter becoming more numerous on steep ground, and down these shoots the logs are worked butt-end foremost with the help of wooden levers.

The check-walls consist of vertical baulks of timber four to five feet in girth, walled in with rocks so as to form strong buttresses against the impact of logs.

On steep slopes the greatest difficulty is experienced in preventing logs getting up speed, as it can easily be imagined that when a log weighing two tons once gets a move on, it smashes down everything in its course and finally dashes itself on rocks hundreds of feet below and is splintered to matchwood. Fortunately the logging gangs are very expert and fearless at this work, and as separate gangs are maintained for repairs to check-walls the percentage of logs badly damaged is extremely small.

I am sorry that the photograph (Plate 29, Fig. 1) does not give a better idea of a log travelling down a shoot on a steep hillside, but confess that it takes a braver man than I am to carry a camera in closer proximity to a steep shoot. The shoot in the photograph Plate 29, Fig. 2 is particularly dangerous on account of the rocks, which are continually loosened by the impact of the logs and crash down the hill.

Wooden Slides.—The shoot often ends above a precipice down which it is impossible to allow logs to fall and above which a very substantial check-wall is erected. Leading from the check-wall is a wooden slide formed of poles morticed to cross-pieces and ending in earthen pits into which the logs shoot. The photograph (Plate 30) gives a better idea than a written description of the way in which slides are taken through precipices after blasting a passage on which the slide rests.

Floating.—Logs are collected in lines near the river bank and are then branded and measured up for payment on a cubic foot

Fig. 1. Logs on a rolling road.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Fig. 2. A log shoot

Photo.-Mechl. Dept., Thomason College, Roorkee.

Fig. 3. A LOG SLIDE THROUGH A PRECIPICE.

basis. They are then pushed into the river and wait for the first spring floods. The Sutlej river is impassable to logs at low water on account of the numerous rocks and cataracts in its channel. These are covered in the summer and logs have to wait for the melting of the snow and the rise of the river.

Except for clearing jams and relaunching stranded logs the logs are left to themselves until they reach the catching depôts commencing where the Sutlej debouches from the hills. Here they are tied into rafts and are taken to the Sales Depôts on the North-Western Railway where they are carefully classified and sold.

Cost of Operations.—It is too soon as yet to give the cost of the present logging operations, as most of the 9,500 logs launched in 1918 are still in the river owing to the exceptionally low level of the Sutlej and Baspa rivers during 1918, caused by the failure of the winter snows and monsoon rains.

The following is the cost of old logging work as given in the Sutlej Valley Working Plan published in 1905 :—

Cost of rolling roads and shoots ...	2·3 pies per cubic foot of timber received in sales depôts.
Cost of felling, logging and working down logs to the river.	One anna to one anna six pies per ditto.
Cost of rafting, etc. ...	One anna six pies per ditto
Total average direct cost exclusive of establishment expenses.	2·58 annas per ditto.

The cost of labour has risen in the last ten years, but the working expenses have not risen so rapidly as the sale prices of timber in the plains, and there can be no question but that the working of timber in the log is most profitable.

At a recent open auction in March 1919 first-class deodar logs realized a record price of Rs. 3 per cubic foot, and although it can hardly be expected that these prices will continue, there is little fear of Government not making a handsome profit on its lumbering, so far at any rate as logs are concerned.

(To be continued.)

June 1919. H. M. GLOVER, I.F.S.

PLANT DISEASES.

In the *Indian Forester*, Vol. XLI, 1915, p. 1, it is stated "of recent years there has been a decided tendency to exaggerate the importance of fungi and to regard them as being the primary cause of most plant diseases. It is believed that this point of view has at once obscured the real causes of many diseases and delayed the application of effective remedial and preventive measures, inasmuch as vital factors, such as soil-moisture-content and soil-aeration, are frequently easier to control on a large scale, both in agriculture and forestry, than are injurious fungi." In the *Kew Bulletin* for 1913 (pp. 343—345), also, the well-known English Mycologist, Mr. Massee, has expressed similar views saying, "experience has proved that fungi undoubtedly are the cause of an enormous loss to cultivators of plants, either as primary or secondary agents, and as the injury caused by the fungus is much more obvious than that produced by the primary cause, it is usually concluded that the injury is entirely due to the fungus, whereas in reality, but for the road being made clear by the primary agent, the fungus, which completes the work of destruction, could not have gained a foothold. For the above reasons I am led to consider that attention to fungi alone is but a poor equipment for a post as Plant Pathologist, and will not lead to a reduction of the losses caused indirectly by fungi, which can never be exterminated."

No one who, like the present writer, owes his botanical training to the inspiring teaching of the late H. Marshall Ward is likely unnecessarily to minimize the importance of fungi. An experience extending over more than 22 years' service in the forests of India, however, has convinced me that œcological factors are of great importance in this question of plant diseases and urgently require detailed study. I have consistently urged this view, for many years, see *Ind. For. Mem. Bot.*, Vol. I, pp. 31,32 (1911), *Ind. For. Rec.*, Vol. V, 4, Part I, pp. 38, 39 (1914); *Journ. As. Soc., Beng.*, Vol. XIV, 1918, No. 6, p. 165, and *Indian Forester*, 1919, pp. 137, 138, and feel strongly that if we are to make real progress, in controlling the diseases of our forest plants, we must develop and expand the

study of œcology, or as it is sometimes termed *field physiology*, and must regard plant diseases as complex problems frequently requiring for their complete solution the combined efforts of a number of experts, such as œcologists, mycologists and biological chemists rather than simple matters which only require for their satisfactory treatment the appointment of a mycologist, glorified possibly by the official title of Plant Pathologist.

In connection with the above remarks, the article on Charles Ogilvie Farquharson given below which is reproduced from the *Kew Bulletin*, 1918, p. 353, is of special interest.

R. S. HOLE,
Forest Botanist.

1st June 1919.

CHARLES OGILVIE FARQUHARSON AND HIS WORK IN WEST AFRICA.

It is with the deepest regret that his friends at Kew have learnt that the name of Mr. C. O. Farquharson, Mycologist, Southern Nigeria, whose appointment was recorded in *Kew Bulletin*, 1911, p. 377, occurs in the list of passengers missing as the result of the loss at sea, through collision of the homeward bound ss. "Burutu" on the night of 3rd October.

The keen enthusiasm brought to bear by Mr. Farquharson on his work, the sound judgment with which he confronted its problems, and the excellence of the results he had already achieved, afforded those interested in the future of West African Agriculture reason to expect for him a useful and distinguished career. We regret the tragic frustration of these hopes and lament the loss of a highly gifted and singularly attractive personality.

The following letter to the Assistant Director, dated 23rd September, and received at Kew on 15th October, was sent by the mail following the ill-fated vessel on which Mr. Farquharson sailed. The letter shows that he had a strong foreboding that his voyage home might end in disaster, and this is also indicated by its despatch by a later mail.

The letter is unlike any of the other letters sent by Mr. Farquharson from time to time to Kew, and is a remarkably graphic epitome of his life-work in Nigeria. The nature of the work, the methods by which he sought to solve the many difficult problems, and the kind of education that his experience had led him to believe best for such work are all fully discussed. The views expressed apply to tropical plant pathology generally and are so worthy of consideration that the letter is published almost in its entirety. It is conceivable that but for his presentiment Mr. Farquharson would not in a single letter have embodied so fully his results and views.

AGRICULTURAL DEPARTMENT,
IBADAN, NIGERIA:
23rd August 1918.

DEAR MR. HILL,

Kew hears so seldom from me that I suppose it has by this time "written me off" a bad example of ingratitude and possibly as a failure. I am writing now because I am ordered home by the next boat, which sails about the beginning of next month. This will be posted by the following boat and will tell you what I have been doing, in case the Boche prevents me telling you what news I have in person. I hope to get home all right and see Kew, but one never knows. At the end of this month I shall have completed 23 months' residence, and it will be bad luck to get done in on the way home. However I want to get home for some things, and one must take the risk.

I may say that you have not heard of me mycologically because, except for rare and brief intervals, I have not been mycologist this whole tour. I have been a Curator, the Curator in charge of the field labour here and at Agege. My scanty daylight leisure I have not devoted to mycology, because Ibadan, or our part of it, is mycologically arid. I do not suppose you wish to be deluged with fungi imperfecti, Phomas, Cladosporiums, and such like. There are no others. So effectively cleared is our place that I rarely see a Mycetozoon. I did them up before the clearance was complete. Under the inspiration of my former

colleague, Dr. Lamborn, and encouraged by Professor Poulton, I have done little bits of entomology in my leisure, and perhaps know as much about the ways of getting at insect life-histories and noting their relations to their environments as any other mycologist in the field and may be a little more. With some knowledge of handling labour gained in 20 odd months' gang driving of some two hundred men, my education, I think, I can consider fairly wide, and in West African conditions, fairly useful.

Forgive this preliminary blast on my own particular trumpet—it is not intended to be a world-resounding affair, but you may not be inclined to agree with some of my views later on and I am merely putting in a varied experience to disarm criticism as far as possible. I ought to add that George Massee's economic mycological outlook has influenced most things I have done, perhaps not published, but in the intimate expression of his views that he used to give at Kew. Again and again I have wished he were alive. Kew wasn't the same place to me last time I was home.

My experience here, especially being in a position in which I was more or less responsible for getting up crops or giving a plausible reason for failure, has convinced me that every mycologist ought to be deprived of his microscope (and perhaps even of his pocket lens) for at least the first tour of his service, and perhaps for two years, and compelled to raise *normal* crops with no artificial aids of any sort. If possible, also, he should be compelled to study a really representative half-dozen drainage problems and see them solved by experts. He would greatly benefit by having to dig a few drains himself. I do not pretend to be an expert, but for the first two months of this tour I did dig drains, bits of them myself, and supervised the digging of an open system, three feet (and even over) deep. I had to do this because I diagnosed asphyxiation to account for defoliation and die-back on some of our cocoa here. Several nights I was so dead tired by 7-30 that I had to turn in without dinner. I had a very bad leave last time, and came back here feeling anything but well. But I saw the water pouring out of a clay subsoil, as each spadeful of soil came out, and in due course I saw the cocoa trees shoot

out leaf-buds everywhere, and that was something. When I read descriptions of "wither-tip" of some crop with elaborate cultural data of some obscure *Phomopsis* or other idiotic fungus, I blush for the quack who wrote it. I know there are other causes of die-back in cocoa and other trees that lack drainage. I have had such problems, but I am convinced that all of them can and must be solved without the aid of 1-12th in. objectives and Bordeaux mixture.

While I am on the subject of mycological quacks, let me tell you that to my mind the most outrageous are the entomogenous fungus "boosters." Massee shattered my faith in them. I had the luck to be in the Jodrell Laboratory when such a fungus came from the States, called *Aegirita Webberi*, named, I think, by Fawcett (California). "Aegirita" Webberi was the haustoria (moniliform clusters of cells) of a Peri-sporiaceous fungus (a sooty mould) which had grown on the secretions of the coccid it was said to kill. I regard the E. F. B.'s aforesaid as quacks, because so far I have met with none who attempted to find out when a coccid or any other insect dies a natural death, or conversely proves insects to be immortal, apart from those carnivorous fungi. Mycologists are not the only people led astray by insects. I know a medical officer out here whose bonnet harbours an insect, not a bee, but the species of *Chrysops* which is the intermediate host of a *Filaria* (*loa*, I think). It doesn't occur here but does in Sapele in particular. The medical officer came here a year or two ago, early in the rains (the spring). Seeing our nice fields of young maize, he asked, almost with a shudder, whether we got much trouble from red fly (*Chrysops*). I said it didn't occur at all, and he refused to believe me. I asked him why it ought to be here, and he told me he was certain its prevalence had a connection with young maize! He was so convinced that it was no use arguing that when the maize is young the dry season is over, the yams are young, the ground-nuts are young, and that, in fact, it was the spring. And the fact is, of course, there *are* no *Chrysops* here. Our mycological bug-slayers overlook the normal seasonal periodicity of insects, and it seems to me

that not a few have sprayed their fungus-spores just when the insect was about to go anyhow. The seasonal periodicity of insects is extremely well marked here. One day, going from my office to my quarters, I probably see dozens of "painted Ladies" (*Pyrameis cardui*). Next day and for a few months they are not. Early in the rains for two or three days thousands of migrating Libytheine butterflies pass here flying southwards. The negro peasant knows that after that he may safely sow his cereal crops—maize, at any rate. Towards the end of the rains swarms of the same butterflies return northwards. One may conclude that the rains are over. Between the flights to and from the forest belt we never see them. Unquestionably some of our insect pests are only pests when the agriculturist has failed. The agriculturist may not like to be told that. He doesn't object to be told to spray. There is a fine "act of God" feeling about it, so fine indeed that he doesn't even spray, but is satisfied with the belief that it *might* be done with success. The notorious West African cocoa "bark-sapper" (*Salbergella* sp.) in my experience is a pest on the careless agriculturist, a deserved visitation. A leading native grower here sent to the Department by one of our native instructors a collection of insect pests that were vexing him. They were bark-sappers. In the absence of our entomologist these things come my way (though I get no official credit). I sent the instructor to the plantation with a list of questions to answer as to the contour of the farm, soil and sub-soil, whether the pest was worst at the top of any slopes on the farm or at the bottom, and if at the bottom whether the land was swampy. He came back, bringing trees (with roots) that he'd dug up. Before he said a word I knew from the stunted, gnarled tap-roots that the trees had grown on the most refractory laterite pan. He told me there was but 4 inch of soil above the laterite, and that the trees were on the top of a slope. At the bottom, near water, on rich soil there wasn't a sapper to be seen. I sent word to the owner that if he really wanted to grow cocoa on such a place he'd have to dig holes and deep, and fill them up with compost. He would know himself, from his normal profit margin, whether the

expense would justify that method or whether it would be better to recognize that laterite was no soil for cocoa. When next I heard of him he had read my report in a meeting of the Agricultural Society of Ibadan and denounced my remedy (and me) as impracticable.

I noticed some time ago that—— ——after listing various non-cocoa host plants of the bark-sapper which ought not to be planted near cocoa plantations (including *Acalypha* hedges in his proscribed list), goes on to mention that though *Salbergella* is a parasite of *Acalypha*, which is a hedge at Aburi, yet the cocoa there appears never to suffer from the bug's attentions. I am strongly inclined to think the reason is that the Aburi cocoa is *cultivated* and is in a position to keep the sapper at a distance. Thrips of cocoa is unquestionably a sequela of misguided agriculture. I hope you will not think I am unduly critical when I say that the average———'s mental outlook is seriously distorted by a smattering of things entomological and mycological. They appear to me to think that because they know a bark-sapper or a root fungus and put down their names correctly that nothing more is to be said than that the trouble has been overcome by Bordeaux mixture or will probably respond to its application.

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If I had to map a course for a plant pathologist, I'd make a year's residence on a farm compulsory and make physiology, systematic and applied (the latter being essentially intensive agriculture and including soil physics and meteorology), the chief subject. I would bar microscopes till the last year of the training. Every spare hour should be in the field. Particularly futile I thought was a course of mycological lectures I once attended, futile because the average student there didn't know what it was to go into the field. Undoubtedly the Aberdeen student under Professor Trail stood a better chance of being able to interpret things as they appear in the field.

Field physiology, as opposed to laboratory physiology studied by means of beakers, tubes and all sorts of ingenious appliances, is a study that wants developing. Let me illustrate my meaning

from my own experience. The optimum planting date for American cotton here is about the 17th of July. Every day planting is delayed after that, in a *normal* rainfall year, increases the risk of a short crop. The great limiting factor after that is the Harmattan which comes on about November or December after the rains have stopped but before any marked response to that—in the way of leaf fall has set in. Once the Harmattan sets in (it is more or less intense from the start) defoliation is rapid. That is followed by a meagre flush of new foliage, the leaves of which are greatly reduced in size. Flowers may still and do continue to appear, but the bolls are undersized, are often badly worm-infested, and when mature their cotton is rarely worth picking. Now you might think it would pay to plant a week or two or even a month earlier, Well, I tested the point by serial plantings, and found that June plantings or even more abnormally early are hopeless; the plants become the prey of the anthracnose fungus, Fusariums, physiological "red rusts," and dear knows what else. By the end of July they are the most stunted, miserable, flowerless, boll-less things you could imagine, blighted beyond recovery. I do not believe that spraying would be of the least good for the fungi (it would never pay on the bread-and-cheese cut-priced cottons we have to grow here), and even if the fungi were eliminated there would still be the other physiological troubles. The ground-nut here is another good instance. Ground-nuts may be planted here up to the end of April (the rains begin with the tornadoes about the end of March or even earlier), or if the rains are late, into May. They will grow magnificent plants of a diameter of six or eight feet if not crowded, and will mature about mid-July or August. Let us say that up to the time when the vine has stopped growing and is on the turn it gets x in. of rain. We used to plant (up to 1914) about June or even later. Planting then, it is quite possible that the crop before the rains stop will get x in. of rain, at times more, at times less. But the bulk of the plants will be stunted, chlorotic, or mottled and yellow, and instead of spreading normally (I am not referring to normal erect-growing types) grow *erect*, the leaves are very much reduced in size, and hardly any nuts are formed.

When I came here in 1912 I never questioned the time of planting. I took it for granted as correct. I found myself up against this bunching and mottling, could neither find insects nor fungi, and the tubercles on the roots were apparently normal. The natives do not grow them much here, and, truth to tell, I didn't think of asking them about the crop. I couldn't get to Northern Nigeria, where I know the nuts *must* grow well, and had to make the best of it. I tried all sorts of ideas, but mainly kept my eyes open for a field clue. I got this indirectly when trying to solve a rather similar cotton (native) type problem. Up to 1914 our highest yield of ground-nuts as harvested amounted to just over 500 lbs. per acre, which would probably have weighed about 300 to 400 lbs. when dry (unshelled nuts). We had many worse than that, that wouldn't bear recording, down to 11 lbs. per acre! Now normally we get from 1,000 to 1,300 lbs of well-dried nuts per acre (equivalent to about a ton as harvested). With the aid of lime, I secured 1,700 lbs. once, but the liming had nothing to do with disease. In a ten-acre field one cannot see a "bunched" plant. The cotton disease that gave me the clue was solved in a different way. Up here "native" cottons are affected by a serious and incurable disease, of "physiological" origin. The plants get contorted. The leaves get covered with intumescences on the underside, and freah in the most extraordinary way. Flowering is greatly reduced, and, of course, bolling. The Upland Cottons (American of our introduction) were never affected. I found the solution of that from sheer field observation. Native plants near the coast, where the humidity average is much higher, grow normally. The key to the problem lay in the fact that the Americans were *upland* cottons. Their hirsuteness is an upland character. The natives (*G. vitifolium* and *peruvianum* strains) are glabrous It took two whole tours before these obvious facts sank into my brain, but I doubt if anybody else would have done any better. The remedy for the disease was to grow the right cotton in the right place. Unfortunately for the cotton spinners, cocoa has long since ousted cotton from the high humidity belt. It was only from noticing a few stray survivors

of bygone cultivation at Bonny that I tumbled to the cause of the trouble.

Before leaving the ground-nut, I may say that my theory to account for the facts is that it is not the leguminous portion of the ground-nut that suffers in the mid-rainy season planting, but the nodule organism that is "diseased" (perhaps from too low a soil temperature during the period immediately after it infects its host, or perhaps even before that it has become "involuted") or because the soil then being at its maximum wetness, the organism in the soil has become involuted. When it does infect the ground-nut it either reverts to its ancestral parasitism, or, being itself at least below par, while not becoming a parasite, is yet unable to fulfil all the terms of the partnership. I may, as I have said, meet a Boche torpedo on the way home. If so, I hope you'll get some one to test my hypothesis. Further, I feel sure that something might emerge from a study of clover sickness along these lines at home. Could you induce someone to carry out serial plantings of clover varieties, both in England and Scotland? In the north of Scotland at least the disease doesn't occur. There may be some factor inhibiting out-of-season germination, either planting custom or meteorological.

Now you will see what I mean by field physiology. I doubt if any of the problems I have mentioned could have been solved in a laboratory, or at any rate only with the utmost difficulty and good fortune. I do not suggest that the problems are solved in the ultimate sense, but at any rate I know the practical remedies, and that is a great deal.

As you know I did find a real fungus disease last year, *Bagnisiopsis Dioscoreæ* (see K. B., 1918, p. 199), not a very serious pest but quite noticeable and very striking indeed. And as you know, perhaps, we have been having a great time with cocoanut budrot. In regard to that disease, it seems to me that too much has been made of *Bacillus coli*, and the elementary fact has been lost sight of that dicotyledenous plants die back following asphyxiation of their roots for want of drainage or other adverse soil

factors. The first symptom is the death of the growing point of the main axis, if there is one, or of that and the side branches. Now, a palm has only got *one* to go on with, outside its fronds, and when that goes there is no hope of recovery. That growing point can "go" exactly as one or many of the growing points of a dicotyledonous tree may, and for the same reasons. The essential remedy is proper cultivation, growing the palms in the proper place on a proper soil in the proper way, with plenty of light and air. People have been so obsessed with the maritime habitat legend that they fail to see that the palm does well there because there are few competitors and it can get abundance of light to seaward and plenty of breeze.

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I hold strong views on cocoa disease out here, and to my thinking the key to the whole problem was indicated in that book by the late Secretary for Native Affairs, when he reminded us that "the native has no State-consciousness." The pest of cocoa *is* the native. He doesn't "cultivate" cocoa. He exploits a "weed" that yields a product closely allied to cocoa. I pointed this out to Government here. The great blight of cocoa is the fact that the native can exploit it at 10*s.* and less per cwt. cost of production of dried cocoa, and for years has sold it at 40*s.* and 50*s.* and even more. The best thing that could happen to Gold Coast and Nigeria native planters would be for them to be brought to the verge of ruin so that they might have to eat bread by the sweat of their brows and not ride in flash motor-cars by the exploitation of a product of the intelligent and painstaking selection of other races which happen to grow well, up to a point, in their country. I told the Government here that cocoa grew like a weed, that in fact it *had* to grow like a weed in order to survive. I illustrated this by reminding them how difficult it is to keep a prize vegetable (raised by long and intelligent selection) up to the prize standard. If it is put on poor land, is untended and generally neglected, it will have to revert to "weed-dom" if it is to survive at all, and if it does it will be no sweet and tender vegetable, but a hard-bitten, fibrous, just edible weed. The only

remedy for West African cocoa is to let in European enterprise to "freeze out" the native if he fail to mend his ways. Cameroons cocoa is the same variety (largely) as Gold Coast and Nigerian, The soils are about the same. The difference in price of their product arises from this fact solely that Cameroons cocoa was prepared by natives as *servants* under the supervision of white men who *had* a State-consciousness and valued their reputations. No amount of preaching will make the native improve. Adversity may force his hand, but he may simply revert to yams and cassava and trading wild stuff. I think he will. In fact people talk at length about the phenomenal progress of cocoa on the Gold Coast. I took it on myself (when acting D. of A.) to tell the Government that it would have been better for the cocoa had the rate of increased production (which isn't progress if the product is the worst that comes into the world's market) been very much slower. I personally believe that the Western Ethiopian is as likely to change his skin as mend his ways. The facts of anthropology and ethnology are against him.

Last month a very interesting disease of Para rubber came my way, from a plantation at Sapele. They sent two large cases containing pieces of rubber tree stems and roots. No details were sent at all. They simply asked what was wrong with them. I could see nothing on the stem except *Diplodia cacaoicola*, which is no parasite of rubber, any more than of cocoa. However, I noticed two small rootlets with knobs on them, about the size of a small hen's egg. I could see they weren't eelworm galls, but was inclined to think the roots were there by accident. One "gall" was not quite so decayed as the other, and in folds or depressions of it I noticed groups of hairs very similar to those of mite galls. Yet I couldn't believe that such things could be made by mites, and a section of the "gall" was not helpful. So I wired for more specimens of the galls, and got them—things like big lumpy potatoes, and some bigger, on *rubber roots* all right. This time came a letter, in which the manager said he also sent a small packet of a bush plant that seemed always to be growing near attacked trees, and wished to know if it had anything to do

with the trouble. I opened up this package and was for the moment stumped. I thought they had nothing to do with the case. Kirby was looking at them, and probably thought the same You will perhaps think I ought to have spotted them at once but I am ashamed to confess that though I had often seen the bush plant I had never collected or studied it; but a dim recollection of Professor Trail's class-room came to me in a flash, and I *knew* it was one of the *Balanophoraceæ*. I think it is *Thonningia sanguinea*. The Yorubas call it Ade-ile—the Crown of the Land, an unusually poetic and pretty fancy for these people. I remembered seeing it frequently in the bush at Agege, so, having to go down there to pay the labour, I looked them up and tried to follow out the roots of one to the bitter end. I take it that the tuberous parts are haustoria. The ordinary roots, which are densely clad with hairs (similar to those of the "galls"), are long things, extremely long for the size of the plants. Some I followed out for six feet or more and failed to find the ends of them. I had very little time, not enough in fact, to trace them to where they joined the host, and had to leave instructions for a native overseer to look for the "tubers." Some labourers apparently had seen the Ade-ile in our rubber plantation there, and so got on to them. Now, in connection with most fungus attacks I have personally seen hundreds of trees dug up from 1912 onwards and never yet met any "tubers" on the roots. What was my surprise when the overseer sent me a perfectly astonishing tuberous mass on one of our rubber trees, quite twice the size of a big human head, and enfolding two quite large Para rubber roots. I am now not a little puzzled over this problem. Has Ade-ile always been there and been overlooked? (The tree on which it had fastened showed no ill effects, and it is not yet clear whether they do so at Sapele.) The plantation has a bad fungus history, and they also must have dug out lots of trees. I feel sure they would have made special records if they had found *Balanophora*. Or has the parasite taken about ten years (from the time the plantation was laid out—ours dates from 1910) to overcome the resistance of the Para rubber tree?

With great regret I had to give a careful study of our stem (post tapping) disease of rubber at Agege the go-by. You may remember that I suggested that the longitudinal cracks on the tapped surfaces are external manifestations of internal "shakes" of the star variety. I saw enough last year, during brief visits to Agege to look after and pay labourers—not to mycologise, of course—to convince me that the touble is physical and perhaps also physiological, and not the sequel to parasitism of any sort. However, I know that it is at its worst at the height of the rains. Four cuts (in the half herring-bone style) were made, and by the end of the season four tracts of outer cortex had been removed each about 4 inches wide.

It was evident at the end of the season that the location of the lesions had a definite periodicity which corresponded, as I have said, to the time when the rains were at their height. It seems to me that the longitudinal "fissures" in the unremoved layer of the cortex are the result of outward pressure of the growing central cylinder on the portion of the cortex weakened by excision of the outer layer in tapping. The weather conditions may either be such that callus-formation or bark-renewal is inhibited, or at any rate on the weakened place cannot keep pace with the excessive rate of growth that presumably occurs at the height of the rains. At any rate I think that phenomenon may be regarded as a "shake" of the cortex whatever the predisposing cause. Fungus attack may follow, but is by no means an invariable consequence, and there is frequently a normal renewal as the dry season ensues. The healed surface in such cases is irregular and "lumpy" and will be difficult ever to tap again, but the important point is that there may be no fungus-attack phase which appears to me strongly to support my hypothesis. If I get knocked out by the Boche you will at any rate be able to suggest to some one to attack the problem on those lines.

Now I must be closing. This letter will come by the mail following the one by which I sail. I hope to have the opportunity to tell you my theories in person and clear up what I have failed to express clearly. I am bringing some good *Balanophora* material,

but apart from that I have nothing this leave. I must again thank Kew for all the help I've had and apologise for the meagre return.

Yours sincerely,
C. O. FARQUHARSON.

CORRESPONDENCE.

TO THE HONORARY EDITOR, *Indian Forester.*

ANALYSES OF SOME MORPHOLOGICAL CHARACTERS OF BOMBAY WOODY SPECIES FROM AN ŒCOLOGICAL STAND-POINT.

SIR,—In your April number Mr. Sedgwick has challenged the generally accepted views that thorns and spines on plants are protective and has put forward an opinion that thorns are "simply due to the tendencies of general development. In the dry regions lignification and general rigidity of all parts is much more pronounced than in the moist." This statement seems to me to be very doubtful and clearly overlooks the large number of succulent plants which are characteristic of dry regions. If the formidable armament of the majority of the Cactaceæ is simply due to climatic causes it is difficult to see how the stems have escaped pronounced lignification. There is no genus which shows a more vigorous and varied development of thorns than Acacia. The majority are found in Australia and Mr. Sedgwick's theory does not explain why the Australian species are mostly unarmed. *Acacia aneura,* the Mulga, an unarmed species is characteristic of the dry interior of Australia and comes from regions quite as dry as the "Karoo thorn" of S. Africa *A. horrida* with thorns 3—4 inches long or the Myrmecophilous acacias of Mexico (*A. Sphaerocephala* and *A. Spadecigera*) in which the thorns are more conspicuous than the leaves. On the other hand the paucity of herbiferous mammals in Australia fully explains this difficulty. The animal theory also explains why trees tend to be much more thorny in their young state than when older. It is common to

find the lower branches of a tree heavily armed whereas the upper ones beyond the reach of browsing animals are scarcely armed at all. Mr. Sedwick's theory requires a tree growing in a dry region to be more thorny in the upper extremities than below since the desiccating action of the wind is there more pronounced.

The fact that goats eat *Acacia arabica* in spite of its thorns is to me no argument whatever against the thorns being protective. In the first place I do not think the thorns were intended to be a protection against goats as the goat is not a natural enemy of *Acacia arabica*. If the interference of man could be eliminated the goat would soon be driven back to the rocky hills from whence it came by its own natural enemies, *e.g.*, leopards. Secondly if the goat were the natural enemy of *Acacia arabica* the fact that it is able to eat it, in spite of its thorns, would show that the goat can adapt itself to changes in its food plants as fast as they become modified. If this were not the case there would be no goats left. Aside from goats, there seems little doubt that the thorns enable *Acacia arabica* to spring up in grazing grounds pretty freely even when other plants are prevented from doing so by cattle.

As regards the "drip-tip" of leaves Mr. Sedgwick shows that this feature is commoner in moist than in dry localities but argues against its utility because it is not more universal. This argument I consider worthless and one might as well say that the fangs of snakes were of no use either for offence or defence because the majority of snakes are non-poisonous. Nature attains her ends in different ways. Some animals escape destruction by fleetness of foot, some by cunning and others by protective armament. Plants too adopt different means to accomplish their ends and one must not expect any feature, however valuable or necessary to an individual, to be adopted universally. The alternative explanation for acuminate leaves suggested by Mr. Sedgwick, namely, that they are due to the vigorous development of the vascular bundles in the midrib seems open to the objection that such vigorous development should be shared by the lateral veins as well as the midrib. Thus acuminate leaves should be lobed and tend to have prominent teeth like the European holly. The fact

that acuminate leaves are frequently entire seems to be a decided objection to Mr. Sedgwick's theory and I prefer the leaf drainage view even though the arguments in favour of it are not very convincing.

CHAMBA :
1st June 1919. } R. N. PARKER, I.F.S.

WAR MEMORIAL.

SIR,—Reference Mr. Parnell's letter in the *Indian Forester* of July 1919 regarding a departmental War Memorial.

If an attempt is to be made, in memory of those who have died, to collect the large sum contemplated by Mr. Parnell, I suggest that the interest be devoted to the relief of the widows and children of those British officers of the department who die in service in India. Even though the necessity of giving such relief will, we hope, occur but rarely, the accumulation and reinvestment of interest will enable more generous relief to be given when the occasion does arise.

I do not agree with Mr. Parnell as to the disposal of this fund partly because his object is not charitable and partly because the granting of a bonus or gratuity for successful research work is or should be the function of Government. A scheme with the final object of relieving Government of an obligation is not likely to induce the sympathy of subscribers.

I feel that if this fund is to be our chief effort, the visible memorial at Dehra Dun should be merely an inscription in some suitable place recording the department's military effort. The record might be confined to the names of those who were engaged on active service overseas or garrison duty in India with casualties, distinctions, etc., while the superscription could be suitably worded to prevent the misinterpretation feared by Mr. Parnell. It is essential in any case to record the names of those who died but, I think, we cannot well do this without paying some tribute to those also, who by the nature of their duties, ran the same risks or

were actually wounded. Under this suggestion the names of those I. A. R. Officers who after their period of training were posted to recruiting or the Simla front, etc., would not be recorded.

E. A. GRESWELL, I.F.S.

EXTRACTS.

THE FORESTRY BILL.

The following is republished from *Nature* of July 31st, 1919:—

"The Forestry Bill, which was brought up in the House of Lords early in the month, has now passed its third reading. The Bill is the first attempt at forestry legislation to be brought before Parliament since the question of afforesting some of the waste lands in the country was first mooted more than thirty years ago. During this period numerous Commissions and Parliamentary Committees were appointed to consider this matter, but no planting was undertaken as a result of their deliberations. It is the war, and the enormous demands for timber, especially the softwoods of the trade, entailed by it, which opened the eyes of the Government to the dangerous position in which Great Britain stood in the matter of timber supplies. The Government Bill now before the country is closely based on the recommendations made by the Forestry Sub-Committee appointed by the late Minister of Reconstruction. It proposes the appointment of a Forestry Authority of seven (reduced to five in the House of Lords) Commissioners and the afforestation of 1,750,000 acres in eighty years, a quarter of a million acres to be planted in the first ten years at a cost of £3,500,000. The total cost of the undertaking will certainly be far greater than the estimates laid before the House, these estimates being very nearly pre-war figures. The Bill was introduced by the Earl of Crawford. It was opposed by Viscount Haldane, whose chief arguments were the danger of erecting

an authority of the kind proposed, which would not be subordinate to any Minister; and possessed of funds drawn from the Consolidated Fund, and not, therefore, placed on the Estimates, and consequently far less open to effective criticism in Parliament. The main point brought about by Lord Haldane, the one really weak part of the Bill from the scientific point of view, is the inadequate manner in which provision is made for future educational and research work and for the representation on the Board of Commissioners of forestry experts possessed of a sound scientific training. In the matter of scientific training and knowledge the proposed Board of Commissioners is a purely amateur one. Unless means can be devised to set up a Board truly representative of what is required—a Board which shall include a strong representation of men provided with a sound scientific training and a wide practical knowledge of forestry conditions throughout the Empire—there is a grave danger that the objects the Bill seeks to achieve will be doomed to failure from the outset, with the resultant disappointment and waste of public funds."

The reference to the absence of practical and scientific experts or the Board of Commissioners and the lack of provision for educational and research work renders the criticism in the last sentence all the more forceful. The British forest authorities could well be guided by the example of the United States of America who organized a research branch almost simultaneously with the creation of an effective forestry department. In India we have been concerned with the creation of a forest estate and in the restoration of irregular or partly ruined forests. It has taken time to convince others of the need for scientific and economic research into the mass of problems which have arisen and will continue to arise, it is therefore hoped that the British forest authorities will not follow in our footsteps but will institute a forest research branch from the very outset. If, as is stated, the Board lacks experts possessed of a sound scientific training the advantages of the creation of an authority independent of any Minister of the Crown will have been entirely frustrated and we must share in the doubts as to ultimate results.

SOME ENZYMES OF THE LEAF OF *LANTANA CAMARA*.

The *Journal of the Indian Institute of Science*, Vol. 2. Part XIII, contains an interesting note on the above.

This investigation was taken up with a view to find out some definite use for this noxious weed which flourishes in almost all parts of this country. The report of Dalzell that an infusion of *Lantana pseudothea* (Syn. *Lippia pseudothea*) is used in Brazil as a substitute for the suggested or possible use of this plant, and accordingly the enzymes present in the leaves of Lantana have been identified and compared with those present in tea leaves. An attempt has also been made to prepare from these leaves a suitable substitute for black tea.

The enzymes present have been identified as—

(i) *Oxidase.* Its activity is perceptible in 3 hours and ends in 39 hours. It gives an intense blue colour with guaicum tincture. More enzymes are present in the tip leaves than in the more mature leaves.

(ii) *Catalase.* It is soluble in common salt solution and is similar to B. catalase of Dr. Loew.

(iii) *Amylase.* It persists even after the fermentation process is over.

(iv) *Invertase.*

(v) *Lipase.* Not ordinarily met with in the leaves of plants.

(vi) *Tanase.* Its absence is not conclusively proved.

(vii) An enzyme which breaks up the glucocides into glucose.

This is perhaps developed during the process of rolling when the cell walls are ruptured.

From the above it is evident that some of the enzymes are similar in character to those present in tea leaves.

Attempts were also made to prepare a substitute for black tea by subjecting the leaves to a process of withering, rolling fermentation and drying. The best results were obtained by withering the leaves for 5 hours at 75°—77° F., rolling them for ¾ hour and then drying for ½ hour at 75° C. after allowing them to ferment for 18 hours. The appearance of the leaves after the above process was black with a faint yellow tinge. The colour of an infusion

prepared from these leaves resembled the colour of an infusion similarly prepared from Lipton's yellow label tea and the flavour was not unpleasant, the greater part of the unpleasant essential oil having escaped during the process of fermentation and drying. With more detailed investigation about the ideal condition of fermentation, drying, etc., it will very likely be possible to prepare a suitable substitute for black tea at an exceedingly cheap cost.

[The above is of interest to forest officers who are concerned with the problem of removing this noxious weed. It does not seem probable that an industry will arise so long as tea cultivation is capable of extension. If, however, a condition arose in which the tea industry could no longer meet the demand it would perhaps be possible to develop a use for Lantana in the direction above described. Lantana flourishes under conditions which are quite unfavourable to tea.—HON. ED.]

DISTRICT FOREST EXHIBITIONS.

An exhibition of forest products was arranged by the South Garhwal Division of the United Provinces on the occasion of a Darbar held by the Commissioner at Srinagar (Garhwal) in March last. The number of visitors from all parts of the district is roughly estimated at 15,000.

There were 176 exhibits of various forest products shown under the following heads :—

Agricultural implements	13
Wooden utensils	4
Furniture (locally made)	3
Miscellaneous wood articles	3
Ringal articles	20
Tans and dyes	3
Medicines and drugs	36
Fish poisons	4
Oil-seeds	7
Gums	6
Chir products	8
Fibres and flosses	28
Famine foods	16
Gunpowder charcoal	2
Skins of carnivorous animals	6

Hill paper	4
Tooth-brushes	4
Miscellaneous products	9

Among the forest cottage industries, the processes of paper-making from *Daphne cannabina,* making of ringal articles and wooden utensils by local turners formed the most interesting feature of the exhibition.

The following notice was placed in the Forestry Section and other places in the exhibition both in English and in the Vernacular of the districts :—

"The extensive Chir forests of Garhwal if worked for turpentine, rosin, tar and pine needle oil will bring in at least another lac of rupees to the district, which will mean more comfort to the people in the way of communication by Railway and an increase in the number of cart-roads, schools and dispensaries, etc., etc. Hence fire-protection of the Chir forests is essential."

To our knowledge, this is the first attempt at holding a district exhibition of forest products in the U. P.—an attempt which, though modest, cannot fail to be useful and we must congratulate Mr. Mathura Prasad Bhola, the D. F. O., upon the idea and its success.

Forest conservancy has recently been inaugurated in the inner hills of Garhwal and has been the cause of considerable anxiety and ill-feeling towards the Forest Department. The forests are of special value to the country, not only as a source of industrial enterprise and means of support to a population that already exceeds the agricultural possibilities of the country, but they represent the only known natural wealth of the locality. As the sources of the springs which supply the bulk of the water to the Ganges Canals these forests have a significance and value far beyond the interests of the local inhabitants. The exhibition therefore presented a means of propaganda work among the local inhabitants which should go far towards removing existing misgivings and misunderstandings and we draw the attention of Forest Officers and others interested in the forests of India to the importance of such exhibitions as a means of educating the people and popularising and developing local industries.

EDITORIAL NOTES.

In a leading article *Nature* of 7th August deals at length with the Forestry Bill which is about to become law in the United Kingdom. This article will well repay perusal as it elaborates the points already brought forward in the note reproduced in this journal.

American Forestry for July is an unusually interesting number. It continues an interesting series of illustrated articles on the work of the American Forestry corps in France. The most interesting contribution is, however, H. Maxwell's account of "Wood used in the Cooperage Industry." The large and varied assortment of American timbers, including saw-mill refuse, used in the cooperage trade indicates that Indian timbers are likely to prove equally adaptable for this purpose. The war has undoubtedly changed conditions as regards the manufacture of barrels in this country for a variety of purposes. We have long been aware that the chir pine (*P. longifolia*) yields a good barrel both for 'tight' and 'slack casks and when Indian engineers awake to the fact that locally manufactured cement can be packed in casks a considerable impetus should be given to the slack barrel grade. Oilseeds, copra, etc., were formerly exported to Europe, but the oil is now largely manufactured in India and there appears to be scope for the development of the tight cask industry. We are not aware that, outside Southern India, this industry has as yet made much progress The United Provinces Government has made a start at the Wood-Working Institute at Bareilly and we have seen excellent samples of tight barrels made by the cooperage class. There is danger that unless the subject is taken up and pushed vigorously steel receptacles will supplant the wooden barrel in all commercial undertakings.

The recommendations of the Board of Forestry regarding the future expansion and scope of the Forest Research Institute at Dehra have borne fruit. A scheme has been prepared for the transfer of the Institute to a new site of about a thousand acres,

at a distance of some four miles from Dehra. On this area it is proposed to erect a much enlarged Institute building, workshops, laboratories, students' quarters, houses for the whole staff and at the same time provide ample room for expansion in the future. An arboretum, experimental and demonstration areas will occupy about half of the total area. Steps have already been taken to acquire a complete equipment in the shape of a creosoting plant, drying kilns, pulp plant, testing machines and fully equipped workshops, which are immediately to be erected. The whole scheme is estimated to cost thirty lakhs of rupees in capital outlay and with additions to the staff in all branches is being referred to the Secretary of State for sanction. Those who have studied the remarks of the Industrial Commission on the requirements of this country in the direction of forest research will welcome this announcement. Our only comment is that the proposed expansion comes rather late in the day and the staff will have its work cut out to keep pace with industrial requirements.

REVIEWS.

REPORT ON THE FORESTS OF BRITISH COLUMUBIA.

We have received a report issued by the Commission of Conversation, Canada, under the title of "Forests of British Columbia." The authors are H. N. Whitford, Ph. D., and Roland D. Craig, F. E.

It will be remembered that at the last meeting of the Board of Forestry Mr. Raitt read a paper urging the necessity of our taking in hand an inventory of the forest resources of this country and of revising our methods of dealing with the commercial world. The work before us, running to over four hundred pages, could well be taken as a guide for the above investigations if ever they are taken up. There is no room for doubt that the Dominion of Canada, although it may have made a late start in organizing a department of Forestry and conserving its forest resources, is now making rapid headway. That there is leeway to make up may be realised from the fact that in British Columbia, the timber on

100,000 square miles, or two-thirds of the land once forested, has been totally destroyed by fire, and on over half of the remaining 55,855 square miles the timber has been seriously damaged. The volume of timber destroyed to date by fire in this province alone is estimated as equal to the existing total growing stock of the entire Dominion.

The geographical, physiographic, climatic and soil relations to the distribution of the forest products are analysed in the first three chapters. The fourth chapter deals with land tenure and traces the development of the various forms of disposal. These are complicated by the existence of provincial as well as dominion forests within British Columbia. About three-quarters of the alienated timber land is held under timber licenses, which originally were of short duration, even as short as one year, and in order to ensure security of tenure and thereby attract capital were extended in 1910 to a term of 21 years. Perpetual licenses renewable from year to year were then introduced allowing, on payment of 20 dollars, continuation of operations so long as there remained "merchantable timber in sufficient quantity to make it commercially valuable." A rental on the land as well as a royalty on the output are leviable. After 1920 the royalties are to be readjusted every five years on the basis of the average wholesale price of lumber, the Government taking a share of the surplus, if any, over certain figure already assessed as allowing a reasonable profit to the lumberman. The Government share in the increase for the various periods is as follows:—

1020—24, 25 per cent.; 1925—29, 30 per cent.; 1930—34, 30 per cent.; 1935—39, 35 per cent.; 1945—49, 40 per cent.; 1950—54, 40 per cent. We quote as follows:—

"This schedule of royalties recognizes three important principles: first, that the public is entitled to a share in the unearned increment due to the increasing timber values; second, that it is unwise to impose a charge which is liable to force the exploitation of the forest resources beyond the market requirements; and third, that security of title is essential in the carrying on of large business enterprises, such as are necessary in the lumber industry of to-day."

In India the minds of forest officers have been troubled with the introduction of clauses into leases which would secure to the tax-payer a share of the enhanced value of our timber and other forest products. The above is suggestive of a line for future action although it cannot be applied to new industries which have not established a representative wholesale price for their products. The wholesale values of lumber throughout America are well known and can be easily ascertained. Similarly teak has an established sale value which is capable of ascertainment in the world's markets so that the principles above enumerated would perhaps be applicable in the case of leases for teak timber and there may be other timbers in the same category.

The forest resources of the province of British Columbia are given according to species and in the minutest detail, with excellent maps of main regions which are usually sub-divided according to the principal lines of extraction such as lakes, rivers and railways. The climate and natural features are described and full particulars given of existing industrial undertakings. To the industrialist who is in search of means of utilizing his capital the book fulfils every possible requirement and its perusal at once gives prominence to many valuable ideas which we can adopt to our own needs. Allusion has been made to certain maps but the two loose maps in a cover-pocket, which illustrate the main types of forest and the distribution of the principal trees are educative works. Thirty-eight excellent photographic plates serve to convey an idea of the country, its forests and principal timber industries. The object of the publication is essentially to maintain or awaken industrial interests and the three years said to have been occupied in its compilation should be time well spent. The following extract is significant:—

"*There is, in India, a most profitable market for Douglas Fir railway ties so treated that they will withstand the attacks of white-ants. The Indian Government is anxious to co-operate in such necessary investigations as will enable it to procure its supplies in Canada.*"

Judging from the point of view of preparedness British Columbia comes on the field with everything in its favour. Shall we continue to lag behind because our problems are too big to tackle?

NOTES ON FOREST POLICY AND FOREST MANAGEMENT.

We have also received a booklet of 16 pages titled "Notes on Forest Policy and Forest Management," by F. A. Lodge, C.I.E., I.-G., Forests, Hyderabad (Deccan). In the preface the author writes :—

"This note has been written in the hope of removing some of the false ideas regarding a much maligned Department, and spreading some little knowledge of the necessity for its existence and the objects it seeks to attain."

After a careful perusal, we cordially invite the attention of all those who are interested in forest matters to study the publication. As a means of disseminating knowledge of the aims and objects of forestry among our politicians Mr. Lodge's notes could well be circulated by all local Governments and reproduced in such publications as are contemplated by Government with a view to remove and counteract mischievous and misleading ideas.

The "notes" are issued by the Bulletin Press, Secunderabad, at the price of one rupee but considerable reductions can be obtained on large orders.